For Reference

NOT TO BE TAKEN FROM THIS ROOM

Ex libris
Universitatis
Albertaensis

The University of Albe
Printing Department
Edmonton, Alberta

THE UNIVERSITY OF ALBERTA

AN INVESTIGATION OF THE ABILITY OF GRADE ONE READERS TO MAKE AUDITORY AND VISUAL DISCRIMINATIONS AND AUDITORY-VISUAL CORRESPONDENCES

BY

© NORMA JEAN ZASADNY

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES
IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE
OF MASTER OF EDUCATION

DEPARTMENT OF ELEMENTARY EDUCATION

EDMONTON, ALBERTA
SPRING, 1971

Thesis
1971
181

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "An Investigation of the Ability of Grade One Readers to Make Auditory and Visual Discriminations and Auditory-Visual Correspondences" submitted by Norma Jean Zasadny in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

The purpose of this study was to investigate the ability of high and low achievers in reading to (a) make auditory discriminations between minimal word pairs, (b) make visual discriminations between word pairs and (c) to make auditory-visual correspondences of sounds represented by one or two letters and ascertain the relationship between auditory and visual discrimination ability, and ability to make correspondences.

After a silent reading test, and visual and auditory screening tests were administered, sixty first grade children either high or low in reading achievement were randomly chosen from four schools in a small northwestern urban centre. Auditory discrimination and visual discrimination were measured using the Fast-Cosens Auditory Discrimination Test and its visual counterpart respectively. The Auditory-Visual Correspondence Test measured the child's ability to verbalize sounds represented by selected letters.

The data analyses consisted of T-tests, and computation of difficulty indexes and correlation coefficients.

Findings indicated that there were significant differences between high and low reading achievers in ability to make auditory and visual discriminations and auditory-visual correspondences.

The same pattern of difficulty emerged when all three criterion tests were analyzed according to achievement group although the low reading achievement group experienced a

greater degree of difficulty. None of the variables of sex, I.Q. or chronological age were found to be significantly correlated with the criterion test scores when the total sample was considered.

The ability to make auditory and visual discriminations appears to be fundamental to making auditory-visual correspondences and children at the end of first grade still encounter different degrees of difficulty with these three operations. The ability to make auditory-visual correspondences was a most difficult task, particularly for low reading achievers.

ACKNOWLEDGEMENTS

The writer wishes to express her sincere gratitude to Dr. Jean Robertson, Chairman of the Thesis Committee for her expert counsel, encouragement, and assistance throughout the planning and writing of this thesis. The assistance of the Committee members Dr. M. Jenkinson, Dr. G. Farmer and Dr. Horowitz was appreciated.

Special thanks is also extended to Dr. G. Cathcart for his assistance with the statistical procedures.

The writer also wishes to express her thanks to the school officials, teachers, and children in the Grande Prairie Public School system for their assistance and co-operation in gathering the research data.

Finally, deep appreciation is extended to my mother who assisted in gathering and scoring the data.

TABLE OF CONTENTS

CHAPTER PAGE

I. SCOPE AND SIGNIFICANCE OF THE PROBLEM 1

The Problem 1

Purpose of the Study 3

Hypothesis 4

Definition of Terms. 6

Design of the Study. 7

Limitations 9

Significance of the Study. 9

Summary of the Chapter 10

II. BACKGROUND AND RELATED RESEARCH STUDIES 12

Background of the Study. 12

Integration Within and Between Modalities 14

Auditory Discrimination as a Factor in Reading Success 16

Relationship of Auditory Discrimination and Reading Ability 16

Summary 20

Auditory Discrimination Ability of Children. 20

Summary 25

Visual Discrimination as a Factor in Reading Success 26

Visual Discrimination of Form and Symbol Stimuli and Its Relationship to Reading Achievement 26

CHAPTER PAGE

Summary 28

Visual Discrimination of Words and Letters and Reading Achievement 29

Summary 33

Visual Discrimination Ability of Children 33

Summary 36

Auditory-Visual Correspondence Ability as a Factor in Reading Success 37

Development of Auditory-Visual Integration Ability in Normal and Retarded Readers . . . 37

Summary 42

Auditory-Visual Integration of Verbal Sounds and Symbols and Its Relationship to Reading Achievement 42

Summary 46

III. THE EXPERIMENTAL DESIGN

The Research Population and Sample 47

Research Population 47

The Test Sample 47

Reading Assessment 47

Auditory Screening. 48

Visual Screening. 49

Neurological Screening. 50

Sex, Age, and Intelligence of Subjects in Sample 50

Screening and Testing Instruments. 52

CHAPTER PAGE

Reading Test 52

Auditory Tests 53

Visual Test 57

Auditory-Visual Correspondence Test . . . 57

Intelligence Test 58

Collection and Treatment of Data 59

Collection of Data 59

Treatment of Data 60

Difficulty of Test Items 61

T-Tests 61

Correlations 61

Summary of the Chapter 61

IV. FINDINGS OF THE STUDY 63

Performance on the Fast-Cosens Auditory Discrimination Test 63

Total Performance of Test Sample: Auditory Discrimination 64

Performance of Total Test Sample on Test Items of Varying Sound Types. 68

Sound Type Difficulties 68

Performance of High and Low Achievers by Voiced and Voiceless Sound Groupings . . 71

Performance of High and Low Achievers by Position of Sound 76

Performance of High and Low Reading Achievers on Like and Unlike Word Pairs 78

CHAPTER PAGE
Summary 81
Student Performance on the Visual Test . . 83
Total Performance of Test Sample: Visual Discrimination 84
Performance of Total Test Sample on Test Items in Which Letters Represent Varying Sound Types 88
Letters Representing Sound Type Difficulties 88
Performance of High and Low Achievers When Letters Represent Voiced and Voiceless Sound Groupings 93
Performance of High and Low Achievers by Position of Letters Representing Sounds. . 98
Performance of High and Low Achievers on Like and Unlike Word Pairs on the Visual Discrimination Test 104
Summary 106
Student Performance on the Auditory-Visual Correspondence Test 108
Total Performance of Test Sample: Auditory-Visual Correspondences 108
Performance of Total Test Sample on Auditory-Visual Correspondences Classified as Various Sound Types 111
Difficulty in Verbalizing Sound Types . . . 113

CHAPTER PAGE

Difficulty Verbalizing Individual Consonant Speech Sounds 121

Summary 125

Correlation of Variables 127

Correlations Between Criterion Variables And Independent Variables 127

Summary 129

V. SUMMARY, CONCLUSIONS, IMPLICATIONS, RECOMMENDATIONS 130

Summary of the Study 130

Summary of the Main Findings 131

Null Hypothesis 1 131

Null Hypothesis 2 132

Null Hypothesis 3 134

Null Hypothesis 4 135

Conclusions of the Study 136

Implications 137

Recommendations for Further Research 139

Concluding Statement 140

BIBLIOGRAPHY 142

APPENDICES 149

Appendix A The Fast-Cosens Auditory Discrimination Test 150

Appendix B Visual Test 159

Appendix C Auditory-Visual Correspondence Test 167

Appendix D Total Scores on Criterion Tests. 175

LIST OF TABLES

TABLE PAGE

I. Distribution of Children with Inadequate Auditory Acuity 48

II. Summary of Mean I.Q., and Chronological Ages of Boys and Girls in the Test Sample. 51

III. Consonant Chart of Voiced and Voiceless Phonemes 57

IV. Performance of Subjects on *Fast-Cosens Auditory Discrimination Test* by Reading Achievement Groups 67

V. Difficulty Levels of Reading Achievement Groups of Sound Types Tested on the *Fast-Cosens Auditory Discrimination Test* 69

VI. Means, Standard Deviation and T-Test Results for Scores of High and Low Achievers on their Discrimination of Sound Type Contrasts 72

VII. Difficulty Levels of Reading Achievers on Voicing of Sound Types on the *Fast-Cosens Auditory Discrimination Test* 73

VIII. Mean, Standard Deviation and T-Test Results of High and Low Reading Achievers on Voiced and Voiceless Sounds 75

IX. Difficulty Levels of Reading Achievement Groups on Position of Sound Types on the *Fast-Cosens Auditory Discrimination Test* 77

X. Means, Standard Deviations and T-Test Results of Comparisons Among Sounds in Initial, Medial and Final Positions for High and Low Reading Achievement Groups 79

TABLE PAGE

XI. Mean, Standard Deviation and T-Test Results of Comparisons Among Like and Unlike Word Pairs on the _Fast-Cosens Auditory Discrimination Test_ 80

XII. Difficulty of Sound Type Contrasts, Sound Type Contrasts by Position, and Sound Type by Voicing For High and Low Reading Achievers on the _Fast-Cosens Auditory Discrimination Test_ 82

XIII. Comparison Performance of Subjects on the _Fast-Cosens Auditory Discrimination Test_ and _Visual Test_ by Reading Achievement Groups 87

XIV. Difficulty Levels of Reading Achievement Groups of Types of Sounds Tested on the _Visual Test_. . 89

XV. Comparison of Difficulty Levels of Types of Sounds Tested on the _Fast-Cosens Auditory Discrimination Test_ and Letters Representing these Sounds on the _Visual Test_ by Achievement Groups. 92

XVI. Means, Standard Deviations and T-Test Results for High and Low Reading Achievers on Total _Visual Test_ in which Letters Represent Sound Types 94

XVII. Difficulty Levels of High and Low Reading Achievers of Letters Representing Voiced and Voiceless Sound Type Contrasts. 95

XVIII. Comparison of Difficulty Levels of Voiced and Voiceless Sound Types Tested on the _Fast-Cosens_

TABLE PAGE

Auditory Discrimination Test and Letters Representing these Sounds on the Visual Test by Reading Achievement Groups 97

XIX. Means, Standard Deviations and T-Test Results of High and Low Reading Achievers on Letters Representing Voiced and Voiceless Sounds. . . . 99

XX. Difficulty Levels of Reading Achievement Groups on Position of Specific Sound Types Tested on the Visual Test 100

XXI. Comparison of High and Low Reading Achievers Scores by Position of Sound on the Fast-Cosens Auditory Discrimination Test and Letters Representing Sounds on the Visual Test. 102

XXII. Means, Standard Deviation and T-Test Results For High and Low Achievers of Comparisons Among Letters Representing Sounds in the Initial, Medial and Final Positions 103

XXIII. Mean, Standard Deviation and T-Test Results of Comparisons Among Like and Unlike Word Pairs on the Visual Test 105

XXIV. Comparative Summary of Most Difficult Items Considering Sound Type, Voicing, and Position by High and Low Reading Achievers 107

XXV. Performance of Subjects on Auditory-Visual Correspondence Test by Reading Achievement Groups. 110

TABLE PAGE

XXVI. Comparison Performance of Subjects on _Fast-Cosens Auditory Discrimination Test, Visual Test_, and _Auditory-Visual Correspondence Test_ by Reading Achievement Groups 112

XXVII. Difficulty Levels of Types of Sounds Tested on the _Auditory-Visual Correspondence Test_ by Reading Achievement Groups. 114

XXVIII. Difficulty Levels of Types of Sounds Tested on the _Fast-Cosens Auditory Discrimination Test_, Letters Representing Sounds on the _Visual Test_ the _Auditory-Visual Correspondence Test_ . . . 116

XXIX. Difficulty of Sound Contrasts by High and Low Reading Achievement Groups on the _Fast-Cosens Auditory Discrimination Test_, _Visual Test_, and _Auditory-Visual Correspondence Test_ 118

XXX. Means, Standard Deviations and T-Test Results For High and Low Reading Achievers on Total _Auditory-Visual Correspondence Test_ and Sound Types 120

XXXI. Difficulty of Phonemes on _Auditory-Visual Correspondence Test_ by Pupil Reading Achievement Groups 122

XXXII. Summary of Ten Most Difficult Phonemes on the _Auditory-Visual Correspondence Test_ 124

XXXIII. Correlation of Sex, Chronological Age and I.Q. with Criterion Variables. . . . .

LIST OF FIGURES

FIGURE PAGE

1. Distribution of Scores on the _Fast-Cosens Auditory Discrimination Test_ 65
2. Distribution of Scores for High and Low Reading Achievers on the _Visual Test_ 85
3. Distribution of Scores for High and Low Reading Achievers on the _Auditory-Visual Correspondence Test_ 109

CHAPTER I

SCOPE AND SIGNIFICANCE OF THE PROBLEM

THE PROBLEM

The major goal in reading is to achieve independence in reading. The ability to associate a letter or group of letters with a speech sound is a valuable means of achieving independence in reading. Learning to make these auditory-visual associations normally begins in first grade. For some children the task of making these auditory-visual associations is very difficult.

In part, reading involves the association of sound with the printed words. The skills involved in associating the printed word with its sound and meaning are considered part of a word perception program. Gray (1960:10) outlines reading as having four components: word perception, comprehension, reaction, and assimilation. For Gray, word perception involves the identification of printed symbols and secondly, calling up the meaning that the author had in mind when he wrote the word.

Word perception is basic to the development of skills and abilities in other aspects of reading. In beginning reading programs much emphasis is placed on word perception. Smith (1963:167) states "Word identification is the most basic of all skill areas. It is the foundation upon which the skills in all other growth areas are laid."

Russell (1961:322) also suggests that word recognition is one of the first steps in the process, involving word

recognition and the application of some form of word analysis when word recognition is not instantaneous. McKee (1966:101) emphasizes the need for definite procedures for unlocking strange printed words independently and practice for learning to recognize familiar printed words instantly.

In recent years, linguistic findings are being applied in the area of word perception. Goodman (1964) and Fries (1963) stress the interrelationship of reading and language. Reading is closely related to ability to understand the spoken language. Spoken language using verbal symbols, is the primary communication system, while print, using graphic symbols, is a secondary communication system based on and derived from speech. Fries (1963) points out that writing represents spoken language. Oral language is represented by auditory patterns produced in a time sequence. Writing represents these auditory patterns in a time and space sequence. In beginning reading programs it is necessary to learn how to respond rapidly and efficiently to the graphic shapes which represent spoken language.

Linguistic approaches to beginning reading stress the importance of decoding print and learning grapheme-phoneme correspondences. Singleton (1966:42) agrees that one of the basic tasks in reading involves decoding. "Words in their printed form are but marks and shapes. They represent a code. The task of reading at this stage lies in unlocking that code or decoding." The child learns that a relationship exists between sound and the letter or

letter combinations used to symbolize them.

Linguists and reading authorities basically agree that sound-symbol associations should be taught. However, there exists some controversy as to the method of teaching this essential skill.

Skill in making sound-symbol associations is dependent upon a number of related learnings. Gibson (1965: 1066) sees three phases involved in beginning reading: discriminating and recognizing graphic symbols; learning to decode letters into sounds, and using higher order units of structure. The child's acquisition of spoken language is partially dependent upon auditory perceptual skills. In order to read printed symbols the child must first possess the ability to differentiate one symbol from another and then decode these visual symbols into the auditory patterns they represent. Auditory and visual perceptual skill are fundamental to forming auditory-visual associations. This study attempts to assess the ability of first grade children in making auditory-visual correspondences and its relationships to their auditory and visual discrimination abilities.

PURPOSE OF THE STUDY

It is generally agreed then that learning auditory-visual correspondences is an essential and effective part of gaining independence in reading. It was the purpose of this study to investigate the ability of high and low achievers in reading to (a) make auditory discriminations between minimal word pairs, (b) make visual discriminations between these same word pairs, and (c) to make auditory-

visual correspondences of sounds represented by only one or two letters. In addition, the study attempted to ascertain the relationships between auditory discrimination and visual discrimination and ability to make auditory-visual correspondences. The study is restricted to selected consonant sounds.

HYPOTHESIS

1. There will be no significant differences in ability of high and low achievers in reading to make auditory discriminations among:
    a. sound contrasts
        I. stop-stop comparisons
        II. nasal - nasal comparisons
        III. semivowel - lateral comparisons
        IV. fricative - fricative comparisons
        V. affricate - fricative comparisons
        VI. fricative - stop comparisons
    b. voiced and voiceless sounds
    c. sounds in initial, medial, and final positions
    d. like and unlike word pairs

    as indicated by their scores on the Fast-Cosens Auditory Discrimination Test.
2. There will be no significant differences in ability of high and low achievers in reading to make visual discriminations among:
    a. letters representing sound contrasts:
        I. stop - stop comparisons

  II. nasal - nasal comparisons
  III. semivowel - lateral comparisons
  IV. fricative - fricative comparisons
  V. affricate - fricative comparisons
  VI. fricative - stop comparisons

b. letters representing voiced and voiceless sounds

c. letters representing sound contrasts in initial, medial and final positions

d. like and unlike word pairs

as indicated by their scores on the visual counterpart of the Fast-Cosens Auditory Discrimination Test.

3. There will be no significant difference in ability of high and low achievers in reading to make auditory-visual correspondences of sounds of the same type when the two sounds are classified as:

  I. stops
  II. nasals
  III. semivowels
  IV. fricatives
  V. affricates
  VI. lateral

as indicated by their scores on the Auditory-Visual Correspondence Test.

4. There will be no significant correlation between sex, chronological age, and intelligence of high and low achievers in reading and

a. auditory discrimination scores on the Fast-Cosens

Auditory Discrimination Test.

b. visual discrimination scores on the visual counterpart of the Fast-Cosens Auditory Discrimination Test.

c. auditory-visual correspondence scores on the Auditory-Visual Correspondence Test.

DEFINITION OF TERMS

The following terms will be used within the context of this study.

1. Auditory discrimination is the ability to hear similarities and differences of speech sounds in words. (Cosens, 1968:5)
2. Visual discrimination is the ability to see similarities and differences of letters in words.
3. Auditory-visual correspondences refers to the ability to associate a speech sound with the one or two letters which represent them.
4. Phoneme is the smallest unit of language which can differentiate one utterance from another. (Gleason, 1955: 9 - 10).
5. A grapheme refers to the minimal visual symbolic unit in the English writing system.
6. High achievers are those students in first grade whose silent reading scores are above stanine 6.5 on the Stanford Achievement Test, Primary 1, Form W.
7. Low achievers are those students in first grade whose silent reading scores are below stanine 3 on the Stanford Achievement Test, Primary 1, Form W.

DESIGN OF THE STUDY

The Sample

The entire grade one population of 266 children attending four elementary public schools of a small urban centre in North Western Alberta was administered the Stanford Achievement Test, Primary 1, Form W. On the basis of scores obtained on the reading test, auditory and visual screening tests, thirty high reading achievers and thirty low reading achievers were chosen from this group as the sample.

Instrumentation

The following groups of tests were administered in this study:

1. Stanford Achievement Test, Primary 1, Form W.
   The reading section of this battery was administered first as the basis for selecting subjects either high or low in reading achievement. The Stanford Achievement Test was administered and scored by the classroom teacher.
2. Fast-Cosens Auditory Discrimination Test.
   This test included 266 test items which were taped and presented individually to each subject. This test measures the ability of the child to discriminate between minimal word pairs, two words which differ by only one phoneme.
3. The visual counterpart of the Fast-Cosens Auditory Discrimination Test. This test included all of the 266 pairs printed in primary type. This test measures the ability of the child to see similarities and differences

of contrasting consonant sounds represented by letters in word pairs.

4. From the visual counterpart of the Fast-Cosens Auditory Discrimination Test, items were selected if the sound contrasted in the word pairs were represented by no more than two letters. The child's task was to verbalize the sound which corresponded to the selected one or two letters.
5. The following data were collected from the cumulative school record of each subject:
    1. sex of the student.
    2. chronological age.
    3. scores on the Otis Quick-Scoring Mental Ability Test, Alpha A, which was administered by the classroom teacher in February and March of the child's first year in school.
6. Individual hearing acuity tests were administered by the investigator to all subjects of the test population and the Public Health Unit Nurses supplied visual screening scores.

Data Analysis

All data were recorded and punched on I.B.M. cards. The data were analyzed using correlations between test scores and the variables: sex, chronological age and intelligence. T-tests were used to assess differences between the mean scores of high and low reading achievers. Mean difficulty index levels indicated the relative difficulty of sound

types. Statistical analysis was done through the computing services, Division of Educational Research, at the University of Alberta.

LIMITATIONS

1. Since varying methods and materials were employed by the classroom teachers, certain children may have received more or less training in auditory and visual discriminations than other children. All children, however, used the _Ginn Basic Reading Series_.

2. The visual screening was confined to use of the _Snellen E Chart_ which detects children with eye problems at far point. Although a good portion of the reading in the classroom is done at a distance, from blackboards and charts, two of the testing instruments required near point vision. The use of a near point test would have confirmed the child's acuity at near point, important for reading from books and in this study for completion of the _Visual Test_ and the _Auditory-Visual Correspondence Test_.

3. Reliability and validity had been established by Fast (1968), Cosens (1968) and Oberg (1969) for the _Fast-Cosens Auditory Discrimination Test_. No reliability index or validity checks were made on the _Visual Test_ or the _Auditory-Visual Correspondence Test_ due to the lack of a computer program which could accommodate the large number of items presented.

SIGNIFICANCE OF THE STUDY

As the child progresses in reading, gradual degrees of

independence must be achieved. The ability to make auditory-visual correspondences is a basic ability need in attacking unfamiliar words. Studies by Barrett (1965), Goins (1958) and Wheatley (1965) have assessed the value of various visual discrimination tasks in predicting reading success. Fast (1968), Cosens (1968) and Oberg (1969) have provided valuable information on the auditory discrimination ability of first grade children. The value of learning auditory-visual correspondences has been recognized, (Dechant, 1964: 174) but little experimental research has been conducted to investigate the relationship between auditory and visual discrimination and ability to make auditory-visual correspondences. Therefore, this study will investigate the relationship between discriminative and intergrative ability in first grade children.

In addition, the findings should contribute to the understanding and instruction of a first grade reading program. This study will provide added insight into the specific difficulties children have when making associations between selected letters and phonemes. The findings of this study should be important for those who are responsible for pre-service training as well as inservice training. It should supply information as to the expected abilities of first grade children in making auditory and visual discriminations and making auditory-visual correspondences and the relationship of discriminative ability with integrative ability.

SUMMARY

There is much research available concerning the relationship between auditory discrimination, visual discrimination, phonic ability and reading achievement. This study will focus on the ability of sixty first grade subjects either high or low achievers in reading, to verbalize sounds represented by one or two letters. This study was needed to give some indication of the relationship between auditory and visual discrimination and ability to verbalize sounds represented by one or two letters. The relative ease and difficulty in verbalizing certain sounds was reported.

CHAPTER II

BACKGROUND AND RELATED RESEARCH STUDIES

This chapter will attempt to provide a background for the investigation of first grade children's ability to make auditory-visual correspondences. Auditory and visual discrimination studies will be included in the review of the literature. Since the research related to the whole area of auditory-visual associations is so extensive only a selected number of studies will be reviewed.

Section one will provide the background related to this investigation. Sections two and three will summarize studies related to auditory and visual discrimination and reading achievement. The importance of making auditory-visual correspondences in reading will be reviewed in section four.

BACKGROUND OF THE STUDY

Reading has been described by Goodman (1963:359) as an active aspect of communication, which involves the recoding of written language into oral language and the decoding of oral language to arrive at the idea. This reconstruction of a spoken message from print involves the transformation of visual information into auditory information. Strickland (1963:168) discusses reading in a similar manner:

> The act of reading involves recognizing the sounds which the letters represent, putting meaning into them, and reacting to that meaning. It is a matter of using the stimulus of the marks on the page to recreate speech.

This description of reading implies that the child has

acquired reasonable facility in hearing separate speech sounds and seeing similarities and differences among letters which represent these sounds. In addition the child must possess the ability to make auditory-visual correspondences.

Learning to read requires discriminative and associative learning. Gibson (1965:1066) points out: "Some aspects of reading must be mastered before others and have an essential function in the sequence of development of the final skill." This ability to discriminate between the sounds of words and the form and letters in words is, in part, prerequisite to development of word perception.

Mastery of the spoken language is an important basis for learning to read since words are representations of speech. McKee (1966:25) sees three important relationships between spoken and printed language:

1. Printed expression stands for the spoken form of that expression as well as meaning itself.
2. Before learning to read, people have had several years of experience in making correct meaning for spoken language.
3. Once the correct associations are made between the symbols that constitute a given printed line and the spoken symbols the print represents, the mental process of making the meaning intended by the writer is essentially the same as that which would be required if he were listening to the writer speak.

By the age of six, most children have incorporated

many of the grammatical complexities of his native language, and can speak and understand it fairly well. The ability to speak and understand the language necessitates that children be able to auditorily discriminate speech sounds. Dechant (1964:113) writes that the child's facility in reading, and certainly his word identification and recognition skill is dependent upon his ability to articulate, enunciate, and pronounce the sounds met in his language. Wepman (1960) and Oberg (1969) concluded that the ability to discriminate speech sounds is developmental in nature and children entering school vary in their abilities to discriminate word pairs.

The ability to make visual discriminations between word forms and letters is also a basic reading ability. Reading is firstly a visual task and the eyes are among the first sensory organs involved. To many children the world of print is a new experience which needs to be discovered and organized. Letters represent speech sounds which when grouped into words have meaning. Gibson (1965:1067) stresses that differentiation of written characters from one another is a preliminary stage to decoding them into speech.

Integration Within And Between Modalities

It must be emphasized that although auditory and visual discrimination ability are necessary for reading, skill in these abilities alone, does not insure success in reading. Meuhl and Kremenak (1966:230) write that auditory discrimination requires children to order and relate sound patterns

on a temporal basis and visual discrimination requires the ordering and relating of letters on a spatial basis as well as a temporal basis. These are integrations within a modality.

Birch and Belmont (1964: 853) suggest that in addition to making integrations within a sense modality, integrations between the auditory and visual senses are also required in learning to read. Auditory-visual integration refers to the ability to establish a relationship between what is heard and the letters representing these sounds. Ayres (1968: 77) writes that reading has some of its foundations in sensory integrations and is a highly complex function of the central nervous system.

Buswell (1959: 108) suggests that one of the first problems in learning to read is in the recognition of printed symbols and then relating them to the corresponding speech sounds. Learning to make auditory-visual association is also stressed by Vernon (1959: 2). "At some point in learning to read the child is taught that each of these shapes is associated characteristically with a sound or sounds, and that a combination of these sounds constitutes the sound of the word." In speech, the child has learned the meanings attached to word sounds.

By the time the child is introduced to reading, he has had many opportunities to integrate information between the auditory and visual senses. To achieve independence in reading however, the child must learn to integrate or

associate the letters he sees in print with the sounds these letters represent. Gibson, et al (1964:88) suggests that children who learn to read well must discover the important grapheme-phoneme correspondences if he is to generate a way to read new words. Jaranko (1969:508) also states that the child using only his visual powers is doomed to failure, for his inability to discriminate among sounds, or his lack of success in using sounds, will act as a barrier to the independent recognition skills essential in handling unknown words.

It would appear then, that the ability to make auditory discriminations of speech sounds in words, and visual discriminations of letters in words are prerequisites in associating letters with their appropriate sounds. This association of letters with appropriate sounds is an important aspect of achieving success in reading.

AUDITORY DISCRIMINATION AS A FACTOR IN READING SUCCESS

Skill in auditory discrimination is essential for success in reading. The importance of discriminating similar speech sounds is basic to developing skill in making auditory-visual correspondences.

Relationship of Auditory Discrimination and Reading Ability

Numerous studies have attempted to determine the relationship of auditory discrimination ability and reading achievement. Murphy and Durrell (1953:556-560) investigated the relationship of ability to identify sounds in spoken words to reading achievement among first second and third grade

children. Significant correlations of 56, .52 and .52 respectively for all three grade levels were obtained between ability to identify sounds in spoken words and reading achievement.

Subsequently Durrell (1954:205) observed that children attending the reading clinic with below first grade reading achievement showed a marked inability to discriminate speech sounds and were unable to use phonics. Phonics can be described as learning to associate a letter or group of letters with its speech equivalent.

Using seventy-eight subjects diagnosed in the University of Chicago Reading Clinic, Poling (1953:107-111) compared the reading performance of subjects either low or high in auditory discrimination. The subjects were divided into high or low groups on the basis of their scores on the auditory orientation and discrimination sections of the Monroe Sherman Group Diagnostic Achievement Test. No statistically significant differences were found between the groups. Therefore Poling concluded that auditory acuity and auditory discrimination are not widespread causes of inefficient word recognition in reading. Poling suggests that auditory memory span is possibly a significant factor in the development of word recognition.

In a more recent study by Poling (1968) auditory discrimination was found to be significantly related to reading achievement. The Wepman Test of Auditory Discrimination was used to ascertain the level of competence

in the auditory discrimination ability of first grade children. Twenty-two children with poor discrimination ability were matched with twenty-two children with good auditory discrimination ability. Findings revealed that children with good auditory discrimination perform significantly better than pupils with poor auditory discrimination. Poling also found that approximately 50 percent of the pupils with poor auditory discrimination at the beginning of first grade showed nearly perfect discrimination by the end of first grade.

Poling also investigated the relationship of other variables with auditory discrimination. No significant differences were found between the mean test scores for boys or girls. Chronological age was considered to be a possible influence so Poling minimized its effect when matching children.

Reid (1962) examined the auditory abilities of 105 grade one children in the Edmonton Public Schools to determine how these abilities related to reading achievement. Auditory ability included acuity, discrimination, and memory. Reid found that auditory memory for sentences, speech sounds, names of sounds, and letters of the alphabet showed a significant relationship with oral and silent reading ability. Auditory discrimination of sounds in words was significantly correlated with reading achievement in October, but the correlation was lower in May.

Reid found that auditory discrimination was not

significantly related to intelligence. Girls tended to be superior to boys in certain auditory skills in October but by June the boys showed equal ability in discriminating word pairs.

A longitudinal study by Thompson (1963) was designed to determine the relation of auditory discrimination and intelligence to success in reading. The investigator studied 105 children who entered first grade in 1958 and were completing second grade in 1960. Auditory discrimination was measured by using Wepman's Auditory Discrimination Test. From the sample twenty-four good and twenty-four poor readers were selected on the basis of reading ages and mental ages. Thompson concluded that auditory discrimination and intelligence are highly correlated with primary reading. In addition she found children improve in auditory discrimination ability from the time they enter first grade. Of those twenty-four children classified as good readers, sixteen possessed adequate auditory discrimination ability at entrance to first grade whereas only one poor reader had achieved adequacy. Thompson recommends that children who have low scores in auditory discrimination ability be introduced slowly to phonics.

Dykstra (1966) carried out a large scale study assessing the relationship between auditory discrimination and subsequent reading achievement. Auditory discrimination tests were administered to 632 subjects at the beginning and end of the first grade. The tests included auditory

discrimination of initial and final consonants in word pairs, rhyming and auditory blending. Dykstra's findings revealed that the intelligence quotient, rhyming, auditory discrimination of ending sounds, and using context and auditory clues were significantly related to reading achievement. Since low correlations ranging from.19 to.43 were found between the auditory discrimination abilities measured and reading achievement, Dykstra cautions that the development of auditory discrimination may contribute to success in beginning reading but that it may not be sufficient to ensure success in mastering the reading task.

Dykstra (1966:19) analyzed the data separately for girls and boys and concluded that development of auditory discrimination skills was slower in boys than in girls. Girls were found to be significantly superior to boys in auditory discrimination ability.

Summary.

The research studies reviewed seem to indicate that auditory discrimination ability and reading achievement are necessary for success in learning to read. This review also suggests that auditory discrimination skill alone does not necessarily ensure success in reading, and other factors such as intelligence, sex, age and other auditory abilities also warrant consideration.

Auditory Discrimination Ability of Children

The following group of research studies have attempted to determine the auditory discrimination ability of children

from kindergarten through grade three.

As part of a large scale cooperative study, Nickolson (1958:16) investigated the ability of 2,188 first grade entrants in identifying beginning and ending sounds. The Murphy-Durrell Diagnostic Reading Readiness Test required the child to select the picture which began or ended like the key word pronounced by the examiner. A large standard deviation score of 23.85 indicated there was a wide range of ability in these children to identify sounds.

Lewis (1959) investigated the auditory discrimination ability of 192 kindergarten children prior to systematic instruction. The auditory discrimination test required the children to discriminate rhyming words, initial, and final sounds in words. Results showed that 50 per cent of the children responded correctly to twenty-three or more of the forty item test. Thirty-three percent were not able to respond correctly on half of the items. The children experienced the greatest amount of difficulty with the section dealing with initial and final sounds.

Wepman (1960:326) studied the capacity of first and second grade children to make auditory discriminations among sounds in word pairs. Wepman's auditory discrimination theory summarizes the findings of his study and experience:

"First there is evidence that the more nearly alike two phonemes are in phonetic structure, the more likely they are to be misinterpreted. Second, individuals differ in their ability to discriminate amoung sounds.

Third, the ability to discriminate frequently matures as late as the end of the child's eighth year.

Fourth, there is a strong positive relation between slow development of auditory discrimination and inaccurate pronunciation.

Fifth, there is a positive relation between poor discrimination and poor reading.

Sixth, while poor discrimination may be at the root of both speech and reading difficulties, it often affects only reading or speaking.

Seventh, there is little if any relation between the development of auditory discrimination and intelligence as measured by most intelligence tests."

Wepman further states that discrimination and ability to retain individual sounds must reach a satisfactory level of development before a child can use word attack skills in reading. The finding also revealed significantly lower reading scores of first and second grade subjects with poor discrimination.

Wepman (1960:331) stresses the relationship between intelligence and auditory discrimination and suggests that more intelligent children are better discriminators because this child can attend to his task, which is necessary for auditory discrimination to function at its best.

Recent studies conducted at the University of Alberta have been concerned with auditory discrimination at the first grade level. On the basis of previous research by Templin

(1954), Miller and Nicely (1966) and Wepman (1960), Fast (1968) and Cosens (1968) devised a comprehensive auditory discrimination test requiring subjects to distinguish similarities and differences between minimal word pairs.

Fast (1968) investigated the relationship between socioeconomic status and auditory discrimination ability. From eight schools, 120 first grade subjects were randomly selected representing low and other than low socioeconomic levels. Each socioeconomic group was then divided in low or other than low reading achievement groups. Using the Fast Cosens Auditory Discrimination Test as a measure of auditory discrimination ability, Fast (1968:146) found that reading achievement and socioeconomic status was significantly related to performance on the Fast Cosens Auditory Discrimination Test. Fast also attempted to identify specific auditory discrimination difficulties when speech sounds were considered in terms of their sound type, voicing, and position. Glides were the easiest type of sound for first grade students to discriminate. The most difficult sound type were nasals. Voiced fricatives were hardest items when voicing was considered. When position was considered, final stops and initial affricates were the most difficult items for the children. The same pattern of difficulty was common to both socioeconomic groups, although the low socioeconomic group experienced a greater degree of difficulty.

Cosens (1968) investigated the effect of training in auditory discrimination on both reading achievement and the

auditory discrimination of grade one children who scored low on the _Fast Cosens Auditory Discrimination Test_. A comparison was made of thirty subjects given auditory discrimination training with thirty not given training. Pre-tests and post-tests for auditory discrimination, auditory acuity, and oral and silent reading were administered. The treatment consisted of a four week taped training program in auditory discrimination at the end of grade one. Cosens (1968:164) found that taped training program resulted in increased scores on total auditory discrimination. Cosens also found that training children low in auditory discrimination at the close of the grade one year did not result in significant improvements in oral or silent reading scores.

Cosens also investigated specific auditory discrimination difficulties first grade children encounter. When sound types were considered, stops and nasals were the two most difficult sound contrasts. Voiceless sounds were easier to discriminate than voiced sounds. Final sounds were significantly more difficult to discriminate than sounds in the initial and medial positions.

Oberg (1969) also investigated the auditory discrimination ability of 160 children in kindergarten and the primary grades using the _Fast Cosens Auditory Discrimination Test_ as a measure of auditory discrimination ability. Oberg (1960; 139) found significant differences between kindergarten and grade two, kindergarten and grade three, and grade one and grade three to auditorily discriminate minimal word pairs.

Oberg also investigated specific auditory discrimination difficulties of speech sounds at the selected graded levels. Significant differences were found between ability to discriminate specific sound type contrasts at the different grade levels. Oberg (1960:143) therefore concluded that auditory discrimination ability appears to be developmental in nature.

All three studies by Fast (1968), Cosens (1968), and Oberg (1969) also investigated the relationship of sex, intelligence, and chronological age with auditory discrimination. Fast (1968:128) and Oberg (1969:142) found no significant difference between performance scores for girls or boys. Cosens (1968:126) reports that boys were slightly superior to girls on discrimination of all sound types in like word pairs.

Fast (1968:127) and Oberg (1969:143) obtained significant correlations at the .01 level of confidence between ability to make auditory discriminations and intelligence, when the total test sample was considered.

Oberg (1968:143) reports that chronological age was significantly related to auditory discrimination when the total test sample was considered.

Summary

From the review of the literature, auditory discrimination appears to be developmental in nature. Children vary in their auditory discrimination ability at the various

grade levels. The literature also suggests that children encounter specific difficulties with certain types of speech sounds. The relationship between independent variables with auditory discrimination is inconclusive, therefore they will be considered in this study.

VISUAL DISCRIMINATION AS A FACTOR IN READING SUCCESS

Visual discrimination ability is also a prerequisite to making auditory-visual correspondences. In order to associate a sound with its appropriate symbol, the child must be able to differentiate similar letters.

Visual Discrimination of Form and Symbol Stimuli and its Relationship to Reading Achievement

Much controversy has existed over the kinds of visual discrimination exercises which will be beneficial in predicting reading success.

Goins (1958) study in part, attempted to ascertain the level of competence in visual perception of 120 grade one children and correlate these abilities with reading achievement. Fourteen non-verbal tests were used to measure perceptual ability. Reading Achievement was measured using the Chicago Reading Tests. Correlations of .49 with reversals and .52 with Copying Patterns and reading achievement in May, were found to be the highest and best predictors of reading success. Goins, however, revealed that many of the perceptual tests did not measure the perceptual abilities in the reading process and are of questionable value.

The relationship of form and symbol matching with reading ability was investigated by Wheatley (1965). A total of 102 first grade children were administered the visual discrimination tests in September. The Gates Primary Reading Test and The Survey of Primary Reading Development were used to measure reading achievement. Findings revealed that form matching was not a difficult task for beginners but pattern copying and pattern completion tasks were difficult for many children. Letter matching was relatively easy, while word matching became increasingly more difficult as differences became more intricate. Correlations between form discrimination tests with reading achievement showed that form reversals were most closely related with reading achievement having significant correlations from .26 to .36. On the symbol discrimination test, word reversals were significantly correlated (.27 to .45) with reading achievement. Wheatley (1965:78) concluded: "Word and letter matching ability make a greater contribution to success in the early stages of reading than is made by form discrimination ability."

Gorelick (1965:315) investigated the effectiveness of training sixty-nine first grade beginners to either discriminate abstract symbols (word configuration outlines) or meaningful symbols (pictures) as compared to a control group who received no discrimination training. The subjects were equated on the basis of sex, age and intelligence. After the discrimination training, all subjects were given

a word recognition program which required them to learn twenty words. Pretest and Posttests in word recognition were administered. The children were again administered word recognition posttests. Results indicated that no significant differences were found in the amount of gain in word recognition between the groups receiving form discrimination training and the control group who received no training.

Barrett (1962) also investigated the value of seven visual discrimination tasks, which were representative of measures used in reading readiness tests, in predicting reading achievement. Each visual discrimination task was ranked in terms of its predictability. A total of 632 first grade children were given the visual discrimination tests as well as the Gates Primary Word Recognition Test and Gates Primary Paragraph Reading Test. Reading letters and numbers, pattern copying, and word matching were the three tasks that correlated highest with reading achievement. Barrett (1962:280) cautions that these measures alone, "do not provide enough predictive precision to warrant their use alone in predicting first grade reading achievement." Chronological age was not considered a valuable predictor of reading success.

Summary

The research findings suggest that visual discrimination of symbol stimuli such as words and letters is a better predictor of subsequent reading achievement than is visual

discrimination of geometric forms and pictures.

Visual Discrimination of Words and Letters and Reading Achievement

If children are to learn sound-symbol correspondences their readiness program must include opportunities to note similarities and differences among letters and words. Research dealing with the types of stimuli which facilitate visual discrimination and subsequent reading of word lists has been investigated.

Edelman (1963) investigated the use of cues in word recognition by non-readers and beginning readers. Subjects were fifty kindergarten and fifty first grade children. The child's task was to indicate which word was like the one that had just been presented. Each of the alternative response words represented a different set of errors. Groups of three letter nonsense words, and five letter nonsense words were presented. A frequency count revealed that the first letter, for both long and short nonsense words, was the cue most utilized by kindergarten and grade one children. Many of the boys recognized five letter words on the last letter as well as the first letter. The shape of words did not serve as a cue as often as did letters. Edelman (1963:8) suggests that:

> . . . the first and last letters of a word stand out in particular in the child's imagery because they are isolated on one side by a white space whereas middle letters are embedded with letters on either side.

Meuhl (1960) investigated the effects of three different types of visual discrimination pretraining on performance of thirty seven kindergarten children learning to read a vocabulary list. The three types of stimulus material presented were (1) the same words as those in a vocabulary list, (2) different words, and (3) geometric forms, and were used in the pretraining program. The learning task required children from each group to learn to read four words in twelve trials. The type of matching pretraining significantly ($p > .05$) affected learning performance. Children who had received matching pretraining using the same words which appeared on the vocabulary list learned to read the list faster than the other groups. When children were asked how they matched words, they revealed it was on the basis of single letters or details. Care should be taken in generalizing these findings due to the small test sample.

In a subsequent study, Meuhl (1961) attempted to determine the stimuli relevant to visual discrimination among word forms. A total of sixty kindergarten children were divided into three groups for pretraining. Group R.R. was given training with words containing relevant letters and shapes, Group I.R. received irrelevant shape but relevant letters in training and the Group L.D. had training in discriminating single relevant letters. After pretraining, the children were required to perform a reading task which required them to match a nonsense word with a

color patch. No reliable performance difference was found between the word trained groups in pretraining or on the reading task. Since no differences were found between the word trained groups, Meuhl assumed that beginning readers discriminate between similar length words on the basis of specific letter differences. Meuhl also suggests that these findings may differ if the shape of the word were lengthened or the position of relevant letters was placed in other than the beginning position.

Learning differences were found between the letter trained group and the word trained groups. In discussing this difference Meuhl reports that the word trained group found more difficulty because they had to notice the location of the relevant letter as well as discriminate this letter from the rest of the word. Meuhl (1961:228) concludes that the relative difficulty in learning to discriminate letters in words can be overcome by providing visual discrimination training with relevant letters before presenting them as parts of words.

Staats, Staats and Schultz (1962) compared the effects of two different types of visual discrimination pretraining on the performance of thirty-six Kindergarten children learning to read four words. Group I received visual discrimination training with the same word while Group II had training with letters making up the words, Group III received no discrimination training. Each child in Groups I and II were given discrimination training and then all were asked to read the

words. There were significant differences at the .05 level of confidence between the mean performance of Group I and the other groups. Those children who received discrimination pretraining using words learned to read the four words in the reading task significantly better. Although Staats, Staats and Schultz found Group I performance superior to the other groups, they do not disregard the value of alphabetic training. They suggest that if children learn phonetic responses to the letters in pretraining the results may be somewhat different. No significant correlations were found between discrimination and reading ability. They suggest that the acquisition of texting does not depend solely on previous acquisition of discrimination skill.

Wheelock and Silvaroli (1967) investigated the difference between children who received visual discrimination training with capital letters to those students receiving no training. Ninety kindergarten children from different socioeconomic levels constituted the experimental and control groups. All were administered visual discrimination sub-tests from Lee Clark Reading Readiness Test and the Letter-Form Training Criterion Test. The experimental group then received training for fifteen minutes each day in recognizing capital letters. The same tests were again administered. Finding indicated significant differences at the .01 level of confidence, in visual discrmination ability favouring the experimental group. The investigators suggest the attention-concentration factor is important in making

visual discriminations. The experimental group in learning to make instant responses to capital letters were learning to attend to the stimuli and concentrate on them.

Summary

The research indicates that visual discrimination training prior to formal reading will be beneficial in the acquisition of a reading vocabulary. However, the type of visual discrimination pretraining which will facilitate associations is inconclusive.

Visual Discrimination Ability of Children

Research studies have dealt with the development of visual discrimination ability and noted specifically the difficulties children encounter when dealing with visual verbal symbols.

Gibson, et al (1962) investigated the development of visual discrimination of letter-like forms in 167 children, four through eight years of age. The subject's task was to match the standard presented, with an identical form and a number of transformations. Two kinds of errors were recorded. Firstly an error to recognize the standard, and secondly failure by selecting a transformation. Transformations included changes from line to curve, perpective, rotations and reversals, and changes in close and break, for example o to c. Findings revealed that the overall error score decreased with age, but difficulty of discrimination for each transformation varied. The greatest developmental change was in tendency to confuse rotations and

reversals, followed by line to curve errors, perspective errors, and close and break errors. Gibson, et al, suggests that although attention and concentration to the task, and preliminary practice are important factors, learning the critical features or dimensions of difference for differentiating letters affects the child's improvement in visual discrimination ability. They hypothesize that fewer errors in close and break transformations result because these same type of differences are critical for object discrimination whereas the other types of transformations are not critical for object discrimination.

Popps (1964) study substantiates Gibson's (1962) findings that most of the errors in discriminating alphabet letters are a result of rotation and reversal transformations. Sixty-five subjects attending kindergarten were tested in February. The child was required to match the stimulus from the alternates presented. The number of errors made on each pair of letters was recorded and results showed b - d, and p - q to be the most confusing. Popps also found that some confusions were caused by a high degree of formal similarity, which refers to the proportion of similar or identical lines contained in both letters.

An early study conducted by Smith (1928) investigated the matching ability of 120 first grade subjects and assessed the difficulty of matching individual lower case letters. The letters b, p, q and d were the most difficult for children to match during the first week in school. Smith attributes

much of the difficulty in children not noticing on which side the loops occur or whether the stems extend upward or downward.

Smith then combined the easiest and most difficult letters to discriminate into nonsense syllable The same testing procedure was carried out. Those syllables containing p, b, d and q at the beginning and end of the nonsense syllable showed slightly higher percentage of error than those syllables containing only one of the most difficult letters. Smith therefore concluded, that difficulties in matching single letters do not carry over to any appreciable extent in matching words.

A cooperative study carried out at Boston University by Nickolson, Olson and Gavel (1958) made an extensive inventory of certain auditory, visual and kinesthetic abilities of first grade children in September, November, February and June and related it to reading achievement.

Nickolsons (1958) study investigated the visual discrimination ability of 2,188 first grade entrants. Visual discrimination tasks which required children to match upper and lower case letters directly were considered an easy task. The lower case letter p showed the greatest number of errors. Ninety-six percent could match twenty-two or more capitals and twenty of the lower case letters. Further tests of direct matching were not carried out. In matching letters from memory, in a multiple-choice situation, nearly ninety percent were able to identify at least twenty capitals while

eighty-three percent identified twenty or more lower case letters. For capitals, the mean score was 23.5 in September and 24.9 in November. (Olson 1968:28). The mean score for lower case letters was 22.19 in September, 23.98 in November and 25.01 in February.

The visual discrimination ability of kindergarten children was also investigated by Lewis (1959). The visual discrimination rest required children to match pictures, geometric forms, letters and word forms. On the total test, ninety-two percent of the 192 children were able to respond correctly to at least seventyfive percent of the test items. Results showed that the visual discrimination of letters and word forms was more difficult than discrimination of non-reading symbols. The children experienced difficulty when the key word to be matched appeared in both its regular and reversed order.

Lewis reported that a significant difference at the .01 level of confidence, was found between chronological age and discrimination ability. As the mean auditory and visual discrimination scores increased the chronological age increased. Sex was reported to have little effect on the child's ability to perform auditory and visual discrimination.

Summary

Visual discrimination appears to be developmental in nature and children vary in their ability to discriminate letters. Certain letters which can be reversed and rotated are among the hardest for young children to visually discriminate. The research evidence suggests that visual

discrimination of reversible letters should be stressed in the reading programs.

AUDITORY-VISUAL CORRESPONDENCE ABILITY AS A FACTOR IN READING SUCCESS

The ability to make auditory-visual correspondences is considered an essential skill in word perception. The child must be able to integrate information within the visual and auditory senses and must also develop skill in associating what he hears with its graphic representation in reading.

Development of Auditory-Visual Integration Ability in Normal and Retarded Readers.

The importance of auditory-visual integrations in contributing to reading success or incompetence has been studied by Birch and Belmont (1964). The test sample consisted of 150 retarded readers and 50 normal readers, all of whom were boys. The mean age of the sample was nine years ten months. An auditory-visual pattern test was administered to all subjects. The subject was required to pick out the visual dot patterns which corresponded to the auditory patterns which were tapped out. Comparisons of mean score difference between normal and retarded readers were significant at the .001 level of confidence. Fourteen percent of the retarded readers made one error or less on this test while forty percent of the normal readers had one error or less.

The relationship of auditory-visual test scores with

reading achievement was also investigated. Those who had low auditory-visual scores also had lower mean reading scores. When I.Q. data for each group was analyzed, it was reported that the relation of auditory-visual pattern test performance to reading was not a direct function of I.Q. differences. Birch and Belmont (1964:860) concluded that ability to integrate auditory and visual stimuli appears to have specific relevance to learning to read and appears to be one of the several factors that contribute to reading ability.

Birch and Belmont (1965) then investigated the hypothesis that ability to make auditory-visual integrations was developmental. Subjects were 220 children from kindergarten through sixth grade, with ages ranging from five years three months, to twelve years one month. Testing procedures were identical to the previous study. Results indicated successive improvements in ability of children to treat patterned auditory and visual stimuli as equivalent up to fifth grade. Growth in auditory-visual integration was most rapid between kindergarten and grade two. Significant correlations from .57 to .34 were found between intelligence and auditory-visual integration, in grade one through to fifth grade.

Birch and Belmont then investigated the relationship between auditory-visual integration scores and reading scores. At the grade one level, correlations of reading readiness with I.Q. was .56 and the correlation between reading readiness and auditory-visual integration was .70

which were significant at the .001 level of confidence. Birch and Belmont (1965:303) concluded that reading in the early grades seems to be more related to the auditory-visual integrative function per se than to intelligence. As the child becomes older, this function becomes more stabilized and is no longer a significant factor in the development of reading competence.

Kahn (1965) also investigated the development of auditory-visual integration and its relationship to reading achievement. The sample included 350 boys from grades two through six. The auditory-visual integration task required subjects to match auditory patterns with its equivalent visual dot pattern. Reading achievement and intelligence was assessed by use of the Metropolitan Reading Achievement Battery, and the Lorge-Thorndike Intelligence Battery. Auditory-visual integration was related to reading achievement with correlation coefficients ranging from .37 to .57. Kahn suggests that the development of auditory-visual integration was an important correlate particularly in the acquisition of vocabulary.

Results showed that a correlation of .51 between chronological age and auditory-visual integration performance. Significant positive correlation was also found between intelligence and auditory-visual integration performance.

An investigateion by Katz and Deutsch (1963) also used only male children in the test sample. Forty-eight Negro boys were chosen from grades one, three and five, and divided

according to reading ability. The Lorge-Thorndike Intelligence Test was administered to all the group. The purpose of the study was to investigate the performance of normal and retarded readers on a task requiring rapid attentional shifts between modalities. The child's task was to press a button each time a light or sound was perceived. Reaction times were automatically recorded. The mean reaction time to stimuli preceeded by a stimulation in a different modality and the same modality were analyzed separately. Significant differences at the .01 level of confidence indicated that normal readers were better able to shift from one modality to another than could retarded readers.

Intelligence was not found to be significantly correlated to auditory-visual shifting ability. Katz and Deutsch (1963:332) conclude that the auditory-visual shifting ability is a perceptual skill basic to reading performance.

Following Birch and Belmont's studies, Muehl and Kremenak (1966:230 - 239) investigated the pre-reader's ability to match information with and between the auditory and visual sense modalities. Using the same matching procedures, 119 first graders were tested. Intercorrelations among the visual-auditory task was .39 and auditory-visual task .52 and reading achievement were significant at .05 level of confidence. The four matching tasks yielded a final correlation of .58 with reading achievement. The performance of high and low readers on the auditory-visual task was examined. Results showed that only one in the high

group readers had a low A-V score, whereas fifty percent or more of the low readers were low scorers on the audio-visual task. The visual-visual matching task was the easiest for children while matching auditory-auditory patterns being the most difficult. Auditory-visual and visual-auditory pattern matching was intermediate in difficulty.

A further study by Berry (1967) was designed to ascertain whether the presentation of a visual stimulus to be matched with one of several auditory alternatives would yield the same results as an auditory stimulus matched with a visual alternative used by Birch and Belmont (1965). Fifteen children receiving remedial instruction at the University of Iowa Clinic were matched on the basis of age, sex and I.Q., with a control group of elementary and junior high students. Three criterion tasks were employed: auditory-visual integration task by Birch and Belmont, a lengthened auditory-visual task and a visual-auditory task. Significant higher scores, at .05 level of confidence, was made by normal readers on audio-visual test, and the lengthened audio-visual test. On the basis of interaction and tests for main effect, Berry concluded that the visual-auditory task discriminated the experimental and control groups. The findings are consistent with previous studies which concluded that tests of audio-visual integration are both useful in predicting and discriminating normal and subaverage readers when intelligence is controlled.

The importance of making sound-symbol associations has

been recognized as a basic ability needed in solving unfamiliar words and achieving independence in reading. The ability to associate a sound with a symbol and its relationship to reading achievement has been investigated.

Summary

The research evidence presented indicates that the ability to make auditory-visual integrations is a perceptual ability which can differentiate good and poor readers. The ability to make auditory-visual integrations like auditory and visual discrimination ability is developmental in nature. The evidence presented is a result of testing procedures using non-verbal symbols and sounds, unlike those used when the actual process of reading takes place.

Auditory-Visual Integration of Verbal Sounds and Symbols And Its Relationship to Reading Achievement

All of the following studies use alphabet letters and speech sounds in determining the relationship of auditory-visual integration to reading achievement.

A study conducted by Harrington and Durrell (1955: 375 - 380) on 500 second grade children investigated the influence of mental age, visual discrimination, auditory discrminiation and phonics on reading. Reading achievement was measured by an oral reading test and a silent reading word classification test. The visual discrimination test required subjects to identify the stimulus word in a multiple-choice situation. The auditory discrimination test measured the subject's ability to notice initial

consonant sounds, rhyming words, final consonants and a combination of initial and final consonants in words. The phonics test involved giving sounds of letters, blends, and knowledge of the silent "e" rule. Using a pairing technique the subjects were paired if they were nearly equal on each of three variables but different on the variable being studied. Using zero-order correlations the four factors studied were as follows: visual discrimination .64, phonics .56, auditory discrimination .54, and mental age .23. Harrington and Durrell concluded that specific instruction on phonics and visual and auditory perception of word elements makes a distinct and different contribution to developing reading skills.

Using a sample of 1,172 first grade children Olsen (1958:29) measured the amount of growth in word perception abilities comparing September scores reported by Nickolson (1958). Children were given tests which required them to identify letters named by the examiner. Olson (1958:29) reports mean score gains in ability to identify both capital and lower case letters, although lower case were still the most difficult. Children were also required to give the names of letters. September scores indicate little familiarity with letter names. February scores indicated that ninety percent could name twenty or more capitals and seventeen or more lower case letters. The mean number of letters written from dictation in September was 10.44 as compared to 22.23 in February. Nickolson and Olson also

tested the child's ability to give sounds represented by letters, omitting q and x. In September 49 percent could not associate lower case letters. Olson (1958:30) reports a mean gain of 14.14 in giving sounds represented by lower case letters in February. Olson further investigated the ability of children to solve new words by substituting the beginning or ending sound with a word read by the examiner. In February an average of ten out of twenty-five words could be read.

When Olson (1958:33) correlated the February reading achievement scores with the various word perception abilities, he concluded that the most useful measures in predicting February reading achievement were those which associate letters with their names. Gaval (1958:42) correlated the September result of 1,506 children with June reading achievement and concluded that September tests which best predicted June reading achievement were: writing letters dictated, naming letters, identifying letters named, and learning rate for words.

The use of a word recognition test as a measure of reading achievement appears to be a limitation of these studies.

Testing 208 first grade children in Missouri, Myers (1966) investigated the effects of selective ordering of letter names, letter names and sounds, and sight words on achievement in word knowledge, word discrimination and comprehension. Three treatment groups were involved.

Group A received instruction in letter names followed by teaching of sight words. Group B received instruction in letter names and sounds followed by sight words. Group C received instruction in sight words followed by teaching of letter names and sounds. Myers concluded that initial instruction in letter names and sounds produced greater achievement in word perception but not in comprehension. This instruction in letter names and sounds aided those children who were average on measures of reading readiness.

Marmon (1966) examined the effects of alphabet recognition and auditory discrimination training on word recognition. The study included 488 kindergarten children in Los Angeles schools. Using Caucasian and Negro children, two separate experiments were run simultaneously. In each experimental group one school received alphabet recognition training, one auditory training and one received a combined approach. Children receiving the combined alphabet recognition and auditory discrimination training received significantly higher scores on word recognition tests.

In another experiment Brown (1966) taught five different consonant letter names and sounds to two kindergarten groups. After a five week training period, eligible subjects were selected and taught ten meaningful words beginning with the consonant taught. The subjects were tested for immediate and delayed recall. No significant differences in performances for any group was evident in immediate recall. However, differences were significant for the delayed recall situation.

Brown concluded that a knowledge of letter names and sounds facilitates delayed recall of words learned through a sight technique. This knowledge appeared to assist boys more than girls.

Summary

The research evidence seems to indicate that measures which require the child to associate a letter with its appropriate sound are useful in predicting reading achievement. An approach which provides opportunities to associate sounds and symbols appears to contribute to word recognition. The importance of associating sounds with symbols is recognized and this study will investigate the child's ability to make these correspondences and outline their difficulties.

CHAPTER III

THE EXPERIMENTAL DESIGN

This chapter is divided into three sections. The first section describes the research population and the sample; section two, the screening and testing instruments. The collection of the data and its statistical treatment is explained in the final section.

THE RESEARCH POPULATION AND SAMPLE

Research Population

The data for this study were collected in June 1969 in a small urban centre in North Western Alberta. All the first grade pupils attending nine regular classes within the public school system were eligible. Any student attending the elementary opportunity class for children of sub-normal intelligence were excluded from the study. A total of 226 subjects from four schools comprised the research population.

The Test Sample

Reading assessment. During the first week in June, the grade one teachers administered and tabulated the reading scores on the Stanford Achievement Test, Primary 1, Form W, for all children in nine first grade classrooms. In order to obtain a sample of high and low achievers in reading, the investigator designated all those subjects receiving a stanine score of 3 or less as poor achievers, and all those subjects receiving a stanine score of 6.5 or more as high achievers in reading. Seventy-nine children were eligible

and the possible research sample at this point consisted of thirty-eight low achievers and forty-one high achievers in reading.

Auditory screening. In June, the investigator administered individual hearing tests using the Zenith Audiometer in order to eliminate the possibility of poor auditory discrimination due to deficient auditory acuity.

On the basis of previous studies by Fast (1968) and Cosens (1968) any child with a hearing loss of 30 decibels or greater at a single frequency was eliminted from the study. Of the seventy-nine subjects tested, fifteen were eliminated because of hearing losses at one or more frequencies.

Table I is a distribution of children having hearing losses in the four elementary schools.

TABLE I

DISTRIBUTION OF CHILDREN WITH INADEQUATE AUDITORY ACUITY

School	Girls	Boys	Low Reading Ach. and Inadequate Acuity	High Reading Ach. & Inadequate Acuity
A	3	1	1	2
B	3	2	3	3
C	3	2	1	4
D	0	1	0	1
Total	9	6	5	10

Approximately 19 percent of the sample had to be eliminated from the study because of hearing losses of 30 decibels at one or more frequencies. These figures suggest that hearing losses occur frequently among first grade children in either high or low reading achievement group. The high reading achievement group who had inadequate hearing acuity were probably better able to overcome this hindrance and still learn to read well although under some strain. Inadequate acuity in the low reading achievement group may have contributed to their poor reading ability. Cosens (1968) found approximately 17 percent of the subjects in her sample had hearing losses of 30 decibels or greater at one or more frequencies. Thirty-six percent of Cosens test sample was considered to have inadequate auditory acuity.

Visual Screening. Visual screening tests using the Snellen E Chart, had been administered to all first grade children during January and February by Public Health Nurses, and the investigator obtained these scores for each child in the test sample. The use of the Snellen E Chart as the only measure of visual acuity has its limitations. Robinson (1953: 12) questions the validity of testing the vision of school children with the Snellen E Chart when more recent acuity tests are available which are better for screening for near point visual problems. Reading from books and the completion of the Visual Test requires visual acuity at about sixteen inches. The Snellen E Chart tests a child's acuity at twenty feet, an adequate rough screening for blackboard and

chart reading, but one which does not confirm adequate acuity for book reading. Since no other visual screening device was available to the investigator the Snellen E Chart scores were used. No children were eliminated from this study from visual scores on the Snellen E Chart. It was possible, however, that children were able to accommodate sufficiently to pass the screening test, and would later experience some eye strain when reading for considerably longer periods of time.

Neurological Screening. Two students who were under observation by the Alberta Guidance Clinic were excluded from the study on the basis that they could not contribute to the study. These children showed an inability to understand the directions and concentrate on the task.

From the original seventy-nine eligible pupils, seventeen were eliminated as a result of auditory and neurological screening, while two were absent due to illness. At this point sixty subjects remained for purposes of this study and constituted the test sample.

Sex, age, and I.Q. of subjects in the sample. Table II summarizes the mean chronological age and intelligence quotient for boys and girls in the high reading achievement group and the low reading achievement group.

In addition, the total means for the high reading achievement group and low reading achievement group are also presented.

TABLE II

SUMMARY OF MEAN I.Q. AND CHRONOLOGICAL AGES OF BOYS AND GIRLS IN THE TEST SAMPLE

Group	Sex	No.of Subjects	Mean I.Q.	Mean C.A (months)
Low Reading Ach. Group	Boys	16	102.1	83.1
	Girls	14	103.1	81.3
Total		30	102.6	82.2
High Reading Ach. Group	Boys	13	117.1	84.1
	Girls	17	121.0	84.2
Total		30	119.1	84.2

The total number of boys was twenty-nine with sixteen in the low reading achievement group and thirteen in the high reading achievement group. There were thirty-one girls in the test sample with fourteen in the low reading achievement group and seventeen in the high reading achievement group. It is not uncommon to find that there are more girls than boys in the high reading achievement group. These sex differences among good and poor readers have been reported by Durrell (1958) and Monroe (1932).

The investigator experienced some difficulty in securing enough boys for the high reading achievement group in this study. In order to incorporate thirteen boys, the investigator adjusted the reading stanine from 7 to 6.5 and designated all those having a stanine score of 6.5 or better

as high reading achievers.

Table II summarizes the mean chronological age of subjects in this study. The mean chronological age of the total sample was 83.25 months, the high reading achievement group was 84.2 months, and the mean chronological age of the low reading achievement group was 82.2 months.

The Otis Quick-Scoring Test of Mental Abilities, Alpha A had been administered in Schools B and C by the classroom teacher during February and March. The investigator administered and scored the Otis Quick-Scoring Test of Mental Abilities to the remaining fourteen children in Schools A and D. The mean intelligence quotient for the group was 110.9 with scores ranging from 83 to 137, and appears to meet what is often referred to as representative of a normal population. Since the mean intelligence scores of each achievement group differed, correlations of intelligence with the three criterion tests were computed.

Many children within the sample had attended kindergarten during the previous year. The final test sample included no repeaters or children with second language problems.

SCREENING AND TESTING INSTRUMENTS

A description of the reading test, auditory tests, visual tests, auditory-visual correspondence test and intelligence test will be given below.

Reading Test

From the Stanford Achievement Test, Primary 1, Form W,

subsections on (a) word reading, (b) paragraph reading, (c) vocabulary, and (d) word analysis skills were used. The word reading test consists of thirty-five items. The student is required to indicate which word represents the picture illustrated. The paragraph reading test is graduated in difficulty. The student's task is to select the correct words which fit the context. There are thirty-nine items in the vocabulary test and it is designed to measure the student's ability to understand oral language usage. The child selects from three words the one read by the teacher. The word study skills section is designed to measure their ability to use phonics.

In Buros (1959, p.656) Robinson concludes that in spite of the limitations, these tests are among the best survey tests of reading achievement for the elementary grades. Townsend's review also agrees that the Standford has many advantages and recommends its use in testing reading achievement.

Auditory Tests.

Auditory acuity. The Zenith Audiometer was used to measure hearing acuity. The Zenith Audiometer is a battery operated machine equipped with earphones for individual testing. The Zenith Audiometer measures hearing at various frequencies and degrees of loss. Myklebust (1964) writes that man is most sensitive to the band of frequencies from 500 to 4000 cycles, which are essential for hearing speech sounds. The decibel refers to the unit of measurement in

sound and expresses the extent to which one sound intensity is greater or less than the zero point. Some children with super acuity would probably hear a tone at the zero point but for most children zero represents a point where no sound is heard.

Auditory discrimination. Auditory discrimination was measured by using the Fast-Cosens Auditory Discrimination Test, which was constructed and used by Fast (1968) and Cosens (1968) at the University of Alberta. In partial fulfilment for a Master's Degree the Fast-Cosens Auditory Discrimination Test was developed for diagnosing student strengths and weaknesses in auditory discrimination.

The work of Templin (1957), Wepman (1960) and Miller and Nicely (1966) provided the necessary research evidence needed for the construction of this 266 item test. Templin's work on articulation errors of children from ages three to eight provided one of the criteria for choice of items. The evidence of discrimination errors by Miller and Nicely was the second basis for choice of items. To cut down the influence of chance on the Fast-Cosens Auditory Discrimination Test three like word pairs and three unlike word pairs were retained for each comparison. Their results of the pilot study were subjected to a test item analysis and the proportion of students making correct responses to any one item was calculated. Any items on which thirty percent did not answer correctly or ninety-five percent responded correctly was not included on the final revision

of the test.

A test item analysis of the Fast-Cosens Auditory Discrimination Test was not computed for this study. However, Cosens (1968:82) found an overall reliability of .95 and Oberg (1969:56) a reliability index of .94. Fast (1968) computed the reliability index for each socioeconomic group and found the indices to be approximately .90 for the low socioeconomic group and .85 for the other than low socioeconomic group.

Content validity was established since Fast and Cosens designed the test on previous research evidence. (Cosens, 1968:81).

In summary, the Fast-Cosens Auditory Discrimination Test was designed to determine a child's ability to recognize minimal differences that exist between the English phonemes used in speech. (Fast, 1968:60). The items chosen required discrimination involving friction, duration, and place of articulation. Criteria for selecting items were based on articulation errors, discrimination errors, and the frequency of sounds in English. The final revision consisted of 266 word pairs. Directions and test items are found in Appendix A.

At this point, it is necessary to define terms used in analyzing the Fast-Cosens Auditory Discrimination Test. The following terms are defined and used by Francis (1958):

Stops; Stops are consonants produced by an air stream that is completely interrupted. Stops include /b, d, g,/

and p, t, k/

Affricate; Affricates are a special class of stops which is released gradually to produce a slight friction noise. Affricates include /č, ǰ/ (č as in church, ǰ as in Jill).

Fricative; Fricatives are produced by a stream of air passing through the constricted opening between an articulator and a point of articulation. Fricatives include / θ, f, s, sh, h/ and /ð, v, z, ž/. (θ as in thin) (ž as in treasure) (ð as in that).

Nasal; Nasals are consonants produced by the closure of the oral cavity forcing the stream of air to pass through the nasal cavity. Nasals include /m, n, ŋ/. (ŋ as in sing).

Lateral; Laterals are consonants produced by closing off most of the air passage of the mouth by placing the tongue against the roof of the mouth while leaving an opening on one or both sides. Laterals include the /l/.

Semivowels; Semivowels are consonants which consist of a rapid movement of the articulators from a characteristic initial position to the position for the vowel that follows, or the reverse. Semivowels include /w, y, r/.

Voiced Sounds; Voiced sounds are produced while the vocal bands vibrate.

Voiceless sounds; Voiceless sounds are produced while the vocal cords do not vibrate.

The English consonant sounds can be described as a certain sound type, being either voiced or voiceless. Table

III, presents the phonemes used in this study.

TABLE III

CONSONANT CHART OF VOICED AND VOICELESS PHONEMES

Sound Type	Voiced	Voiceless
Stops	/b, d, g/	/p, t, k/
Nasals	/m, n, ŋ/	
Fricatives	/ð, v, z, ž/	/θ, f, s, š/
Affricates	/č/	/ǰ/
Semivowels	/w, r,/	
Laterals	/l/	

A tape recording of the original *Fast-Cosens Auditory Discrimination Test* was made by the Audio-Visual Department at the University of Alberta to ensure that the same stress, pitch quality, and time was presented to each child.

Visual Test

A visual counterpart of the 266 test items on the *Fast-Cosens Auditory Discrimination Test* was prepared using a primary typewriter. To avoid confusion errors, only one column of word pairs were presented on each page. The directions and test items are found in Appendix B.

Auditory-Visual Correspondence Test

The *Auditory-Visual Correspondence Test* incorporated only 246 of the 266 word pair items found in the *Fast-Cosens Auditory Discrimination Test*. Any word containing a sound represented by more than two letters was not included in this test. There were twenty such items. Children in first grade are not familiar with sounds represented by

more than two letters, for example tch. The test items were printed on 8" x 11" paper using a primary typewriter. The directions and test items are found in Appendix C.

Scoring the Tests

All the test items were introduced in word pairs. If the child made the correct response auditorily and then visually, for example between cog - cob, he was given one point. In scoring the Auditory-Visual Correspondence Test, the child received one point if he could verbalize /b/ in cob, as well as /g/ in cog. No points were given if only one phoneme was verbalized correctly. Although the nature of the task differed in the case of the Auditory-Visual Correspondence Test, the investigator decided to make a few changes as possible. The word pair form and scoring were kept uniform throughout the three tests given. In the auditory and visual tests the child was required to make one discrimination between the two words of the word pair to receive one scored point, and in the Auditory-Visual Correspondence Test make two associations, one in each word in order to receive one point.

Intelligence Test

The intelligence quotient on the Otis Quick-Scoring Test of Mental Abilities, Alpha A, is derived from the scores on both the verbal and non-verbal subsections. The non-verbal section consists of pictorial forms. The student is required to mark the picture which does not belong in each group. The verbal test requires pupils to follow teacher read directions. The test included 180 items and is given in two sittings. In

Buros (1959, p.362) Yakes reviews the Otis Quick-Scoring Mental Ability Tests and reports:

> If it is required, for example, to segregate pupils into relatively homogenous groups for teaching, administrative or research purposes, tests of this kind can afford a satisfactory rough classification.

The Otis Quick-Scoring Test of Mental Abilities, Alpha A, provided a satisfactory measure of intelligence for purposes of this study.

COLLECTION AND TREATMENT OF DATA

Collection of Data

Auditory Acuity. The child was seated with his back to the investigator so he could not see how the audiometer was operated. Children were directed to raise their hand or lower their hand when they heard a buzz. Steps were taken to ensure that each child knew what type of sound to listen for by practicing directions when it was certain he could hear the type of sound he was to identify. Frequencies of 250, 500, 750, 1000, 1500, 2000, 3000, 4000, 6000, and 8000 were measured.

Auditory discrimination. The child listened to the word pairs presented and indicated by means of a hand signal whether the word sounded the same or different to him. Six practice pairs were presented to ensure that each child understood the directions.

The test was given in three periods with a brief break between each period. The length of the period varied with the ability of the child to concentrate.

An assistant was trained to administer and score the test. Two children were tested at one sitting. A divider was placed between them to prevent them observing each other's responses.

Visual Test. The visual test was administered to each group of subjects by the investigator. No specific time limit was set for completion of the test. Usually the children took between thirty-five to forty-five minutes to complete it. Subjects were given a break during the test. Those subjects who were extremely slow, were given an opportunity to complete the test another day.

Three practice items were illustrated on the blackboard for the children. The children were required to look at each word pair and indicate by means of an X if the words were different. The word pairs were left unmarked if they were the same.

Auditory-visual test. Each child was tested individually by the investigator. Rapport was established with each child before proceeding with the directions. The investigator pointed to one or two letters in each word of each word pair tested and instructed the child to verbalize the sound. If the child did not know the sound he voluntarily shook his head or indicated that he could not associate the sound with the letter.

Sex, age and I.Q. The sex, age and intelligence quotient for each child was obtained from the school cumulative record files.

All scores were recorded and punched on I.B.M. cards for each child.

Treatment of the Data

Difficulty index of test items. The difficulty index was computed for each item. The items were then grouped according to sound type. The mean difficulty index level indicated the proportion of students who made correct responses to a group of items. The mean difficulty index was computed for each reading achievement group to assess the weaknesses and strengths each group encountered with the auditory discrimination test, the visual discrimination test, and the auditory-visual correspondence test.

T-tests. To test the significant differences between high and low reading achievers' mean performances in making auditory discriminations, visual discriminations and auditory-visual correspondences on specific sound types, t-tests were employed. (Hypothesis 1, 2, 3.)

Pearson Product Moment Correlation Coefficients. Correlation coefficients between the auditory discrimination test scores, the visual test scores, and the auditory-visual test scores were computed for each of the reading achievement groups. In addition correlations of each of the three total test scores obtained by the children with each of sex, age and intelligence were computed. (Hypothesis 4.)

SUMMARY

The Standford Achievement Test, Primary 1, Form W,

(reading section) was used to select high and low reading achievers. Sixty subjects for this study were chosen on the basis of these reading scores and individual hearing and visual screening tests. Thirty subjects were designated as high reading achievers and thirty were low reading achievers.

The Fast-Cosens Auditory Discrimination Test was described in greater detail for it serves as a basis for the visual discrimination test and auditory-visual correspondence test. The Otis Quick-Scoring Mental Abilities Test, Alpha A, scores gave a measure of intellectual capacity. The data were analyzed using t-tests and correlations.

CHAPTER IV

FINDINGS OF THE STUDY

This chapter examines the data obtained in the present study which investigated the ability of sixty first grade children either high or low in reading achievement to make auditory discriminations, visual discriminations and sound symbol associations. Three major sections are outlined in this chapter. Section one analyzes the performance of the test sample on the Fast-Cosens Auditory Discrimination Test. This analysis will report the difficulties children have in discriminating sound types. Section two follows with an analysis of the performance of the test sample on the Visual Test, reporting the difficulties children have in visually discriminating letters which represent sound types. Section three completes the sequence by analyzing the performance of the test sample on the Auditory-Visual Correspondence Test. This analysis reports the sound-letter symbol association problems of children. The influence of age, sex, and intelligence on pupil performance on the three tests above will also be considered in the section preceding the summary.

PERFORMANCE ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

The mean difficulty index level, the difference between the means, and the percentage of difference between the means were calculated for each sound type for each student group. Sounds were also considered in terms of their voicing and position. Like and unlike word pairs were compared.

T-tests assessed the difference between the scores of high and low reading achievement groups with the various variables outlined.

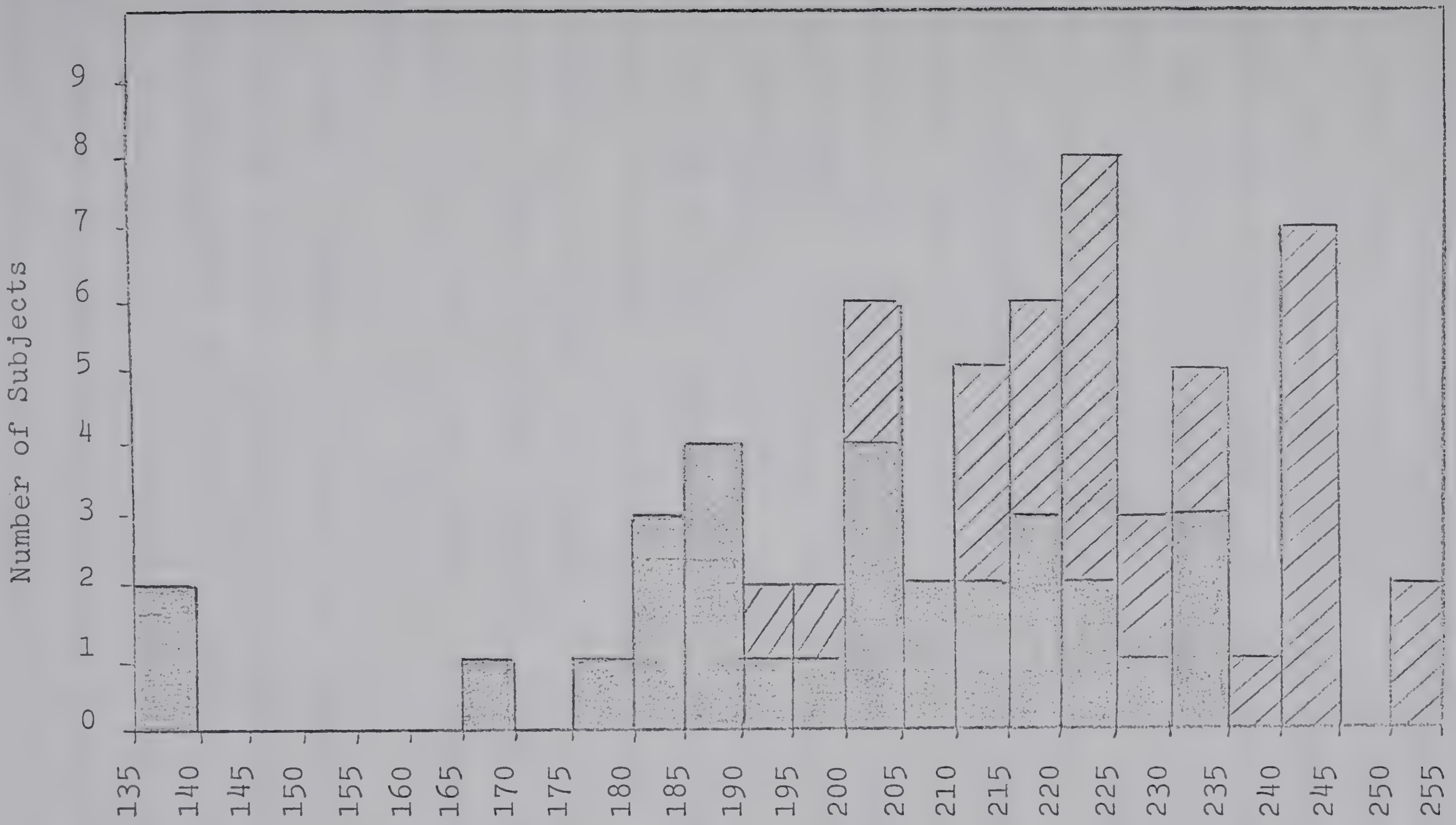
Total Performance of Test Sample: Auditory Discrimination

Figure I indicates the distribution of total scores by high and low reading achievers on the Fast-Cosens Auditory Discrimination Test.

The distribution of test scores ranged from 115 to 255 on the Fast-Cosens Auditory Discrimination Test. The total possible score was 255. The mean for the high reading achievement group was 226.13 and the standard deviation was 15.97. The mean for the low reading achievement group was 201.30 and the standard deviation was 25.02.

In a recent study Poling (1968:140) used the upper and lower quartiles as cut-off points in determining good and poor discriminators. If children could correctly discriminate 90 percent of the items on the Wepman Auditory Discrimination Test they were considered to have reached a high level of competence. Children discriminating fewer than 70 percent of the items were designated as poor discriminators.

Scores on the Fast-Cosens Auditory Discrimination Test indicate that 27 percent of the high reading achievement group could discriminate 90 percent of the items while none of the low reading achievement group could reach this level. In the high reading achievement group 86 percent got 80 percent of the test items correct while 37 percent



DISTRIBUTION OF SCORES ON FAST-COSENS AUDITORY DISCRIMINATION TEST

▨ Low Reading Achievers ▨ High Reading Achievers

FIGURE I

of the low achievement group got 80 percent of the items correct. Since the length of the Fast-Cosens Auditory Discrimination Test is considerably longer in duration than the Wepman Auditory Discrimination Test, parallels between the studies cannot be rigidly drawn. The distribution scores for the high reading achievement group indicate performance was at a high level. The distribution scores for the high reading achievement group tended to be more homogeneous and show less variability than the distribution scores for the low reading achievement group. Performance by the low achievement group was at a much lower level than performance by the high reading achievement group. The distribution of scores for the low reading achievement group showed a greater range indicating that they were more heterogeneous as a group. This apparent difference between high and low reading achievers may be attributed to their differences in intelligence scores and their ability to attend to the task. The scores of the low reading achievement group may result from poorer facility with oral language which serves as the basis of development in reading skills.

Table IV presents the mean, and standard deviation of high and low reading achievers on the Fast-Cosens Auditory Discrimination Test to support the summary of this section.

In summary then, the performance of the low reading group showed more variability in range of scores and standard deviation. The clustering of scores for the

TABLE IV

PERFORMANCE OF SUBJECTS ON FAST-COSENS AUDITORY DISCRIMINATION TEST BY READING ACHIEVEMENT GROUPS

Student Group	No. of Students	Test Mean 266/266	S.D.
High Achievers in Reading	30	226.13	15.97
Low Achievers in Reading	30	201.30	25.02
Total	60	213.70	24.38

high reading achievement group indicated that this group's performance is more homogeneous in auditorily discriminating minimal differences in word pairs. The high reading achievement group's performance was at a high level. The low reading achievement group scores tended to be at a lower level, indicating that many children within this group found auditory discrimination of minimal word pairs a difficult task.

Performance of Total Test Sample on Test Items of Varying Sound Types

In order to determine the ability of high and low reading achievers to discriminate sound types, the scores on the Fast-Cosens Auditory Discrimination Test were grouped by types and analyzed.

Sound type difficulties. A total of 133 unlike word pairs were categorized and used in calculating the mean difficulty index level for each of the sound types. Table V indicates the difficulty levels of sound types tested on the Fast-Cosens Auditory Discrimination Test when the sounds of one type were contrasted with the same sound type or another sound type.

The results showed that the sound type contrast most easily discriminated by high and low reading achievers were semivowels with laterals. Fast (1968), Cosens (1968), and Oberg (1969) also found that subjects performed significantly better on semivowel-lateral comparisons than on any other sound type comparison at the grade one level.

TABLE V

DIFFICULTY LEVELS OF READING ACHIEVEMENT GROUPS OF SOUND TYPES TEST ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Sound Type Contrasts	No. of Items	Reading Ach. Group	Mean Diff. Index Level of Item	Diff. Between Means	% of Diff. Between Means	Order of Difficulty	
						High Ach. Group	Low Ach. Group
Stop-Stop	24	High Low	.793 .583	.210	21	2	5
Nasal-Nasal	11	High Low	.754 .592	.152	15	3	1
Semivowel-lateral	11	High Low	.884 .729	.155	16	6	6
Fricatives	48	High Low	.772 .599	.173	17	4	3
Fricative-Affricate	16	High Low	.768 .514	.254	25	1	2
Stop-Fricative	23	High Low	.784 .605	.179	18	5	4

Nasals were the most difficult sound type contrast for the high reading achievement group to discriminate. In the nasal category 75 percent of the high reading achievers responded correctly. Cosens (1968) and Oberg (1969) report that nasals were among the most difficult sound type contrast to discriminate. The affricate-fricative comparisons were the most difficult category for low achievers to discriminate with only 51 percent responding correctly to items in this category. Carroll (1960:746) rearranged Templin's (1957) data on articulation in terms of separate phonemes. He reports that by the age of six the only sounds which were not correctly articulated by 90 percent of the subjects were s, sh, th, z, zh, hw, and ch. It is not surprising therefore to find that some children have difficulty auditorily discriminating affricate-fricative comparisons when many of the affricates and fricatives are among the last phonemes articulated correctly.

With exception of the semivowel-lateral contrast, the low reading achievement group found all types of sounds difficult to discriminate. Between 50 to 60 percent of the low reading achievement group responded correctly. Performance was at a low level considering they had a 50 percent chance of being correct most of the time.

In comparison 75 percent or better responded correctly to items in each sound category in the high reading achievement group. Although the performance scores were still

short of the 90 percent cut off point chosen by Poling, this investigator believed that 75 percent or better indicated a high level of competence considering the length of the testing instrument used in this study and the concentration it required.

Table VI indicates that significant differences exist between high and low reading achievers on ability to discriminate the various sound types.

The t-test results reveal that the auditory discrimination ability of low reading achievement groups in any sound type category is significantly lower than the high reading achievement group. The inadequate auditory discrimination by the low group generally may be a result of their inability to concentrate for the length of the test. Most found the task of discriminating 266 word pairs very tedious. Some soon lost their initial interest and had to be constantly reminded about the task, in spite of their frequent breaks. Benger (1966) found the concentration factor a most critical factor in predicting reading success. Most children in the high reading achievement group found the task of discriminating word pairs more enjoyable and less tedious.

Performance of High and Low Achievers by Voiced and Voiceless Sound Groupings

The English consonant phonemes are classified as either voiced or voiceless. Table VII outlines voicing in regard to specific sound types. Consideration is given to stops

TABLE VI

MEANS, STANDARD DEVIATION AND T-TEST RESULTS FOR SCORES OF HIGH AND LOW ACHIEVERS ON THEIR DISCRIMINATION OF SOUND TYPE CONTRASTS

All Sound Contrasts	No.of Items	High Achievers Mean	S.D.	Low Achievers Mean	S.D.	"t"-score	P.2
Auditory Test	266	226.13	15.97	201.3	25.02	4.505 **	.0000
Stop-Stop	24	19.13	3.10	14.67	4.61	4.329 **	.0000
Nasal-Nasal	11	8.57	1.78	6.67	2.47	3.361 **	.0013
Semivowel-Lateral	8	6.09	1.35	6.07	1.67	2.073 *	.0426
Fricative-Fricative	48	36.43	6.03	29.07	7.65	4.074 **	.0001
Affricate-Fricative	16	12.33	2.20	8.67	3.31	4.971 **	.0000
Fricative-Stop	23	18.17	3.25	14.03	4.83	3.823 **	.0032

** Significant at the .01 level of confidence for a two-tailed test when t-test score reaches 2.66

* Significant at the .05 level of confidence for a two-tailed test when t-test score reaches 2.00 (The semivowel-lateral exception appears to be an artifact of the program and is unexplainable.)

TABLE VII

DIFFICULTY LEVELS OF READING ACHIEVERS ON VOICING OF SOUND TYPES ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Voicing	Sound Type	Difficulty Index For: High Ach. Group	Order of Difficulty	Low Ach. Group	Order of Difficulty
Voiced	Stop-Stop	.825	8	.651	8
	Nasal-Nasal	.754	3	.592	7
	Semivowel-Lateral	.884	10	.729	10
	Fricative-Fricative	.682	1	.522	4
	Fricative Affricate	.728	2	.485	1
	Fricative-Stop	.784	5	.586	6
Voiceless	Stop-Stop	.773	4	.542	3
	Fricative-Fricative	.857	9	.666	9
	Fricative Affricate	.800	7	.507	2
	Fricative-Stop	.787	6	.583	5

and fricatives as they are the only two categories which have both voiced and voiceless sounds. Nasals, semivowels, and laterals are all voiced.

With the exception of the semivowel-lateral category results indicate that the voiceless fricatives were the easiest for both achievement groups to discriminate. Eighty-six percent of the high reading achievement group and 67 percent of the low reading achievement group responded correctly to items in the voiceless fricative category. Fast (1968) also found that voiceless fricatives were the easiest to discriminate among first grade subjects. Voiced fricatives were the hardest sound type category for the high reading achievers to discriminate. The low reading achievement group also found voiced fricatives difficult to discriminate although this group had so many other difficulties too, that comparitively the voiced fricative-fricative category ranked fourth in difficulty. Voiced and voiceless affricate-fricative comparisons were the most difficult sound type contrasts for the low reading achievement group to discriminate.

Table VIII presents the mean, percentage of difference between the means, standard deviation and t-test results of high and low reading achievement groups on voiced and voiceless sounds.

T-tests show that there were significant differences between high and low reading achievers on performance on voiced and voiceless sounds. However, only small

TABLE VIII

MEAN, STANDARD DEVIATION AND T-TEST RESULTS OF HIGH AND LOW READING ACHIEVERS ON VOICED AND VOICELESS SOUNDS

Voicing	No.of Items	High Reading Ach. Group			Low Reading Ach. Group			"T"-Score
		Mean	Mean % Difference	S.D	Mean	Mean % Difference	S.D	
Voiced Sounds	67	53.53	20.1	7.21	41.23	38.4	11.28	4.949 **
Voiceless Sounds	66	51.57	21.8	6.86	39.93	39.5	11.09	4.862 **

** Significant at .01 level of confidence when t-score reaches 2.66

* Significant at .05 level of confidence when t-score reaches 2.00

differences in mean performances exist between voiced and voiceless sounds within either the high reading achievement group or the low reading achievement group.

Performance of High and Low Reading Achievers by Position of Sound

Table IX indicates the difficulty index level of each achievement group on position of sound types tested on the Fast-Cosens Auditory Discrimination Test. Semivowel-lateral comparisons in the initial and medial positions were the easiest to discriminate for both the high and low reading achievement groups. Templin (1957) and Fast (1968) found initial sounds easiest to discriminate. The majority of semivowel-lateral comparisons were made in the initial position which may account for this finding. Semivowel-lateral comparisons were also the easiest sound type for both groups to discriminate.

The low reading achievement group found initial affricate-fricative, final affricate-fricatives, and medial affricate-fricatives the three most difficult sound contrasts. The findings are understandable, since the low reading achievement group had the greatest difficulty with affricate-fricative comparisons when sound types were analyzed minimizing voicing and position.

The three most difficult sound types for the high reading achievement group to discriminate were initial affricate-fricatives, initial fricative-fricatives, and final nasal-nasal comparisons. Nasals and affricate-fricative

TABLE IX

DIFFICULTY LEVELS OF READING ACHIEVEMENT GROUPS ON POSITION OF SOUND TYPES ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Sound Type Contrast	Achievement Group	No.of Items	Position of Sound in Words:					
			Initial	No.of Items	Medial	No.of Items	Final
Stop-Stop	High	0	---	6	.766	18	.802
	Low		---		.551		.593
Nasal-Nasal	High	0	---	5	.806	6	.711
	Low		---		.627		.563
Semivowel-Lateral	High	9	.885	2	.866	0	---
	Low		.739		.741		---
Fricative-Fricative	High	15	.693	13	.812	20	.805
	Low		.560		.612		.620
Affricate-Fricative	High	3	.566	7	.800	6	.811
	Low		.367		.546		.517
Fricative-Stop	High	12	.791	0	---	11	.778
	Low		.623		---		.586

comparisons were the most difficult for the high reading achievement group when sound type was maximized.

The mean, percentage of difference between the mean, standard deviation and t-test results for sounds in each position is outlined in Table X.

Table X indicates that there were significant differences between high and low reading achievement groups on ability to discriminate sounds in the initial, medial, and final positions. Within each achievement group, children generally found that sounds in the medial position were easiest to discriminate while sounds in the initial position were hardest to discriminate. Cosens (1968) found sounds in the medial position were easiest to discriminate but reports that final sounds were the most difficult. Children in the low reading achievement group found sounds in initial, medial, and final positions equally hard to discriminate as indicated by the small mean percentage differences. Perhaps the easier task of discriminating sound differences in the medial position may be due to the phonological environment on both sides of the medial sounds aiding in discriminating sounds in this position.

Performance of High and Low Reading Achievers on Like and Unlike Word Pairs

There were a total of 133 like and 133 unlike word pairs on the *Fast-Cosens Auditory Discrimination Test*. Table XI indicates the mean, mean percentage of difference, standard deviation and t-test results for like and unlike word pairs.

TABLE X

MEANS, STANDARD DEVIATIONS AND T-TEST RESULTS OF COMPARISONS AMONG SOUNDS IN INITIAL, MEDIAL AND FINAL POSITIONS FOR HIGH AND LOW READING ACHIEVEMENT GROUPS

Position of Sound	Total Possible Score	High Achievers			Low Achievers			"T"-Score
		Mean	Mean % Difference	S.D	Mean	Mean % Difference	S.D	
Initial	80	66.30	17.1	5.32	59.90	25.1	6.57	4.076 **
Medial	66	57.27	13.2	4.22	50.53	23.4	7.15	4.336 **
Final	120	102.87	14.3	8.05	90.70	24.4	12.45	4.427 **

** Significant at the .01 level of confidence when t-score reaches 2.66

* Significant at the .05 level of confidence when t-score reaches 2.00

TABLE XI

MEAN, STANDARD DEVIATION AND T-TEST RESULTS OF COMPARISONS AMONG LIKE AND UNLIKE WORD PAIRS ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Word Pairs	No. of Items	Reading Achievement Group:						"T"-Score
		High Achievers			Low Achievers			
		Mean	Mean % Difficulty	S.D	Mean	Mean % Difficulty	S.D	
Like	133	122.03	7.5	8.42	120.67	9.2	11.02	.0531
Unlike	133	104.10	21.9	14.43	80.70	39.3	4.85	4.85 **

** Significant at .01 level of confidence when t-score reaches 2.66

* Significant at .05 level of confidence when t-score reaches 2.00

Both the high and low reading achievement groups found it easier to discriminate similarities in speech sounds than hearing differences. The mean for the high achievement group in discriminating like word pairs was 122.03 and the mean for unlike word pairs was 104.10. The mean for the low reading achievement group in discriminating like word pairs was 120.67, and for unlike word pairs was 80.70. Vernon (1952) explains that in the perceptual process, abstracting similarities is an easier task than perceiving differences. Blank (1968) found that retarded readers were set to perceive two words as the same while normal readers were set to perceive them as different. This explanation may help to account for the lower mean score of the low reading achievement group on unlike word pairs.

Summary

Table XII summarizes the findings of the high and low reading achievement groups with regard to sound type, voicing and position of sound in words. The three most difficult categories are listed.

The findings set forth previously reveal that children low in reading achievement have more difficulty with auditory discrimination of speech sounds than those children high in reading achievement. From Table XII it appears that when voicing and position are analyzed, both high and low reading achievement groups have difficulties which tend to be closely associated with those same sound types which proved to be the most difficult.

TABLE XII

DIFFICULTY OF SOUND TYPE CONTRASTS, SOUND TYPE CONTRASTS BY POSITION, AND SOUND TYPE CONTRASTS BY VOICING FOR HIGH AND LOW READING ACHIEVERS ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST

Reading Achievement Group	Order of Diff.	Sound Type	Voicing *	Position **
High	1	Nasal-Nasal	Vd Fricative Fricative	I. Affricate Fricative
	2	Affricate Fricative	Vd Affricate-Fricative	I. Fricative Fricative
	3	Fricative Fricative	Vd Nasal-Nasal	F. Nasal-Nasal
Low	1	Affricate-Fricative	Vd Affricate-Fricative	I. Affricate-Fricative
	2.	Stop-Stop	Vl Affricate-Fricative	M. Affricate-Fricative
	3.	Nasal-Nasal	Vd Fricative-Fricative	I. Fricative-Fricative

* Vd - voiced

Vl - voiceless

** I. - Initial

M. - Medial

F. - Final

An analysis of the scores revealed that the sound type contrast most easily discriminated were semivowel-lateral comparisons. Nasals and affricate-fricative comparisons were the most difficult sound type for high reading achievers to discriminate, while the most difficult type for the low reading achievers was the affricate-fricative comparisons. Voiced sounds were generally almost as easy to discriminate as voiceless sounds. When position was considered, initial sounds were hardest to discriminate. The high reading achievement group's performance on the Fast-Cosens Auditory Discrimination Test was significantly better than the performance scores of the low reading achievement group. The poorer performance scores by the low reading achievement group indicates that the task of auditorily discriminating word pairs on the Fast-Cosens Auditory Discrimination Test was difficult for them.

STUDENT PERFORMANCE ON THE VISUAL DISCRIMINATION TEST

The student scores in this section were analyzed in the same manner as outlined in the preceding section. The mean difficulty index level, the difference between the means, and the precentage of difference between the means were calculated for each sound type represented by letters. T-tests assessed the differences in performance between high and low achievement groups. Comparisons will be made between student performance on the auditory discrimination test and the Visual Test.

Total Performance of Test Sample: Visual Discrimination

Figure 2 indicates the distribution of scores by high and low reading achievers on the visual counterpart of the Fast-Cosens Auditory Discrimination Test.

The total test scores on the Visual Test ranged from 146 to 266. The total possible test score was 266. The mean for the high reading achievement group was 259.83 and the standard deviation was 6.22. The mean for the low reading achievement group was 234.47 and the standard deviation was 26.58.

Findings indicate that 93 percent of the pupils got 81 percent of the test items correct. Total performance of the test sample was at a high level. The distribution of scores for the low reading achievement group ranged from 145 to 266 while the range for the high reading achievement was only 233 to 266. Again the performance by the high reading achievement group was higher than the performance of the low reading achievement group, and the scores tended to cluster around the mean. A possible explanation for better performance by high reading achievers on both the auditory discrimination test and the visual discrimination test may be that these children mature earlier and are able to discriminate better than low reading achievers. The high reading achievement group showed more skill in making auditory discriminations of minimal word pairs. These same children were better able to visually discriminate differences between word pairs as well. It appeared that

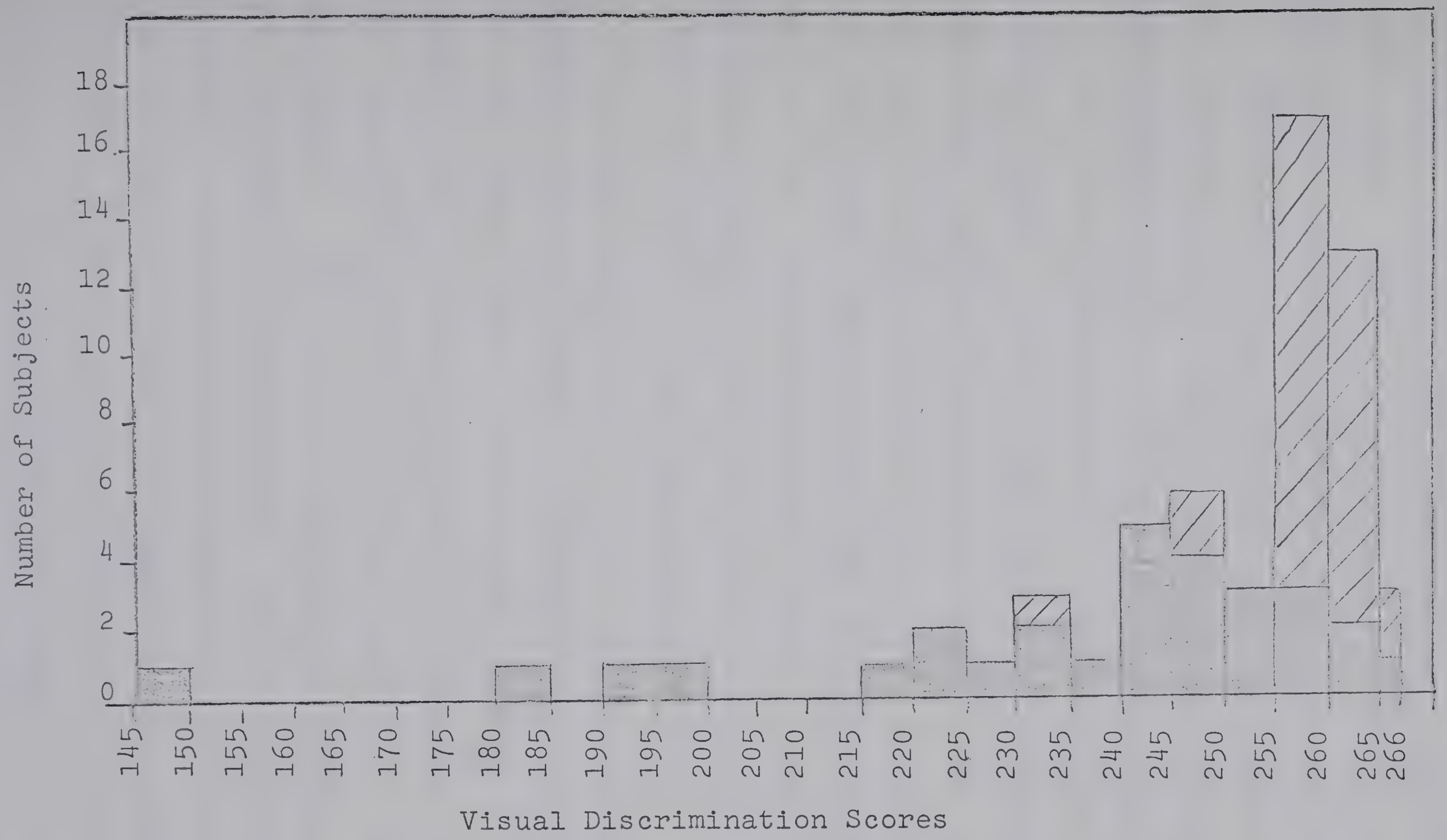


FIGURE 2

DISTRIBUTION OF SCORES FOR HIGH AND LOW READING ACHIEVERS ON THE VISUAL TEST

▢ Low Reading Achievers ▨ High Reading Achievers

the high reading achievement group had developed more efficient methods of seeing differences in words. Children in this group could perceive differences and similarities at a faster rate. They seldom resorted to counting letters in each word or matching letter for letter in each word.

Table XIII compares the mean, standard deviation of high and low reading achievers on the Fast-Cosens Auditory Discrimination Test with those on the Visual Test.

The level of performance in both reading achievement groups is higher on the Visual Test than performance on the Fast-Cosens Auditory Discrimination Test. The mean difference between scores on the auditory discrimination test and visual discrimination test is approximately the same for both reading achievement groups. However, the performance level for the high reading achievement group was higher in both tests than the performance level of the low reading achievement group. Scores for the high and low reading achievement group on the auditory discrimination test were more like a normal distribution, although the high reading group's scores were negatively skewed. Scores on the visual discrimination test were negatively skewed for both groups. The low achievement group, however, showed more variability in performance. The mean score gain attained in comparing the performance on the visual test with the auditory test was the same for both groups. This indicates that children low in reading achievement have difficulties in making auditory discriminations and tend to

TABLE XIII

COMPARISON PERFORMANCE OF SUBJECTS ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST AND VISUAL TEST BY READING ACHIEVEMENT GROUPS

Group	No. of Subjects	Auditory Test Means 266/266	Visual Test Means 266/266	Auditory Test S.D.	Visual Test S.D.
High	30	226.13	259.83	15.97	6.22
Low	30	201.3	234.47	25.02	26.58
TOTAL	60	213.7	247.15	24.38	23.09

have the same amount of difficulty making visual discriminations even though their level of performance was at a higher level.

Generally children found the task of making visual discriminations between word pairs much easier than auditorily discriminating these same word pairs. Since the *Visual Test* was administered to groups of children it was impossible to control the number of times a child was allowed to look over the word pairs. Therefore, children had the opportunity of going back over word pairs without a restricted time limit. The auditory discrimination test made no provisions for the children to hear the same word twice.

Since all children had an opportunity to progress at their own rate, perhaps high reading achievers were better able to use the discrimination skills they had learned in auditorily discriminating word pairs to assist them in the discrimination of letters.

Performance of Total Test Sample on Test Items in Which Letters Represent Varying Sound Types

In order to ascertain the ability of high and low reading achievers to visually discriminate sound types represented by letters, the scores on the *Visual Test* were analyzed.

Letters representing sound type difficulties. Table XIV indicates the difficulty index level of letters representing sound types as tested on the *Visual Test*. The *Visual Test* presents those word pairs, in primer print, as heard on the *Fast-Cosens Auditory Discrimination Test*.

TABLE XIV

DIFFICULTY LEVELS OF READING ACHIEVEMENT GROUPS OF TYPES OF SOUNDS TESTED ON THE VISUAL TEST

Sound Type	No.of Items	Reading Ach. Group	Mean Difficulty Level of Items	Diff. between Means	% of Diff. Between Means
Stop-Stop	24	High	.913	.174	17
		Low	.739		
Nasal-Nasal	11	High	.954	.199	20
		Low	.755		
Semivowel-Lateral	11	High	.971	.100	10
		Low	.871		
Fricative-Fricative	48	High	.956	.149	15
		Low	.807		
Affricate-Fricatives	16	High	.958	.243	24
		Low	.715		
Stops-Fricatives	23	High	.984	.109	11
		Low	.875		

The child's task was to indicate if the word pairs presented were the exact same or different. Only the unlike word pairs were used to calculate the difficulty index as it was impossible to determine which letters triggered the incorrect response in like pairs.

Performance scores on the Visual Test indicate that children in the high reading achievement group responded correctly to at least 91 percent of the test items while at least 72 percent of the low reading achievement group responded correctly to items in any sound type contrast. On the Fast-Cosens Auditory Discrimination Test children in the high reading achievement group responded correctly to at least 75 percent of the items in any sound category, while students low in reading achievement responded correctly to at least 51 percent of the items. The performance scores of the high reading achievement group on the Visual Test then was at a very high level while the low reading achievement group's performance was much poorer than those of the high achievers.

The results show that the sound type contrast most easily visually discriminated by both the high and low reading achievement groups was the stop-fricative comparisons. Ninety-eight percent of the high reading achievement group and 88 percent of the low reading achievement group responded correctly to items in this category. Each stop is represented by one letter, while each fricative in a number of cases is represented by two letters. This fact may

account for the high performance of all children in seeing differences between stop-fricative comparisons.

The letters representing affricate-fricatives were the most difficult sound type for the low reading achievement group to visually discriminate. Such word pair comparisons as sheep-cheap, witches-wishes, were difficult with only 71 percent of the children in the low reading achievement group responding correctly to test items within this category.

The second most difficult letters representing sound types for the low reading achievement group were the stop-stop comparisons. Only 73 percent responded correctly to items in this category. The stop-stop category was also the most difficult for the high achievement group to visually discriminate. Performance on all letters representing sound types by the high achievement group was at a high level with 91 percent or more responding correctly. Many of the stops may be difficult to discriminate for some children since phonemes such as /b/, /d/, /g/ and /p/, are often reversed and rotated by first grade children. Gibson (1963) found that the greatest percentage of errors were due to rotations and reversals among children.

Table XV compares the performance scores of high and low reading achievement groups on sound contrasts and letters representing the same sound contrasts.

The findings reveal that the low reading achievement group experienced difficulty with the same sound type contrasts when the word pairs were presented either auditorily

TABLE XV

COMPARISON OF DIFFICULTY LEVELS OF TYPES OF SOUNDS TESTED ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST AND LETTERS REPRESENTING THESE SOUNDS ON THE VISUAL TEST BY ACHIEVEMENT GROUP

Student Group	Sound Type Contrast	Difficulty Indexes for: Auditory Discrimination Test	Difficulty Indexes for: Visual Discrimination Test
High Reading Achievers	Stop-Stop	.793	.913
	Nasal-Nasal	.754	.954
	Semivowel-lateral	.884	.971
	Fricative-Fricative	.772	.956
	Affricate-Fricative	.768	.958
	Fricative-Stop	.785	.984
Low Reading Achievers	Stop-stop	.583	.739
	Nasal-Nasal	.592	.755
	Semivowel-lateral	.729	.871
	Fricative-Fricative	.599	.807
	Affricate-Fricative	.514	.715
	Fricative-Stop	.605	.875

or visually. Although similar patterns of difficulty exist, the level of performance by sound type contrasts on the Visual Test is much higher. The high reading achievement group possess more skill in discriminating both sounds and the letters representing them.

Perhaps children in the high reading group learn to discriminate auditorily at an earlier age and this discrimination may have a transfer effect assisting them in discriminating letters when they begin to read.

Table XVI presents the means, standard deviation and t-test results of the visual discrimination of letters representing sound type contrasts.

The findings reveal that significant differences exist between high and low reading achievers to make visual discriminations of letters representing any sound type contrasts. Children in the high reading achievement group appeared to have developed a more rapid and efficient strategy of seeing differences in word pairs. These children seemed better able to look at the entire word and retain its general configuration and details while comparing it to the other word pair. Their perceptions were more rapid and accurate than those exhibited by children in the low reading achievement group.

Performance of High and Low Achievers When Letters Represent Voiced or Voiceless Sound Groupings

Table XVII indicates the difficulty index when the letters representing sound types are considered in terms of voicing.

TABLE XVI

MEANS, STANDARD DEVIATIONS AND T-TEST RESULTS FOR HIGH AND LOW READING ACHIEVERS ON TOTAL VISUAL TEST IN WHICH LETTERS REPRESENT SOUND TYPES

All Sound Contrast	No. of Items	High Achievers		Low Achievers		"T"-Score	P.2
		Mean	S.D.	Mean	S.D.		
Visual Test	266	259.83	6.22	234.47	26.58	5.004 **	.0000
Stop-Stop	24	21.97	1.87	17.80	5.14	4.102 **	.0001
Nasal-Nasal	11	10.50	.81	8.40	2.60	4.151 **	.0001
Semivowel-Lateral	8	7.87	.34	6.77	1.02	5.497 **	.0000
Fricative-Fricative	48	46.07	2.86	38.70	7.77	4.790 **	.0000
Affricate-Fricative	16	15.30	1.19	11.77	3.20	5.573 **	.0000
Fricative-Stop	23	22.60	.61	20.77	2.20	4.322 **	.0000

** Significant at .01 level of confidence for a two-tailed test when t-score reaches 2.66

* Significant at .05 level of confidence for a two-tailed test when t-score reaches 2.00

TABLE XVII

DIFFICULTY LEVELS OF HIGH AND LOW READING ACHIEVERS OF LETTERS REPRESENTING VOICED AND VOICELESS SOUND TYPE CONTRASTS

Voicing	Sound Type	Difficulty Index for: High Achievers	Order of Diff.	Low Achievers	Order of Diff.
Voiced	Stop-Stop	.844	1	.644	1
	Nasal-Nasal	.954	4	.755	4
	Semivowel-Lateral	.971	6	.871	10
	Fricative-Fricative	.981	9	.775	7
	Fricative-Affricate	.971	6	.667	2
	Fricative-Stop	.980	8	.860	9
Voiceless	Stop-Stop	.955	5	.757	5
	Fricative-Fricative	.945	2	.760	6
	Fricative-Affricate	.948	2	.711	3
	Fricative-Stop	.991	10	.820	8

Findings show that both the reading achievement groups found letters representing stop-stop comparisons the most difficult to visually discriminate. The stops phonemes /b/, /g/, and /d/ are all voiced. Many children experienced trouble with (b) and (d) because these letters were often reversed. Smith (1928) reported that the graphemes b, p, and d, were among the graphemes with the highest percentage of error.

The high reading achievement group found voiceless fricative-fricative and voiceless fricative-affricate the hardest to visually discriminate. These phonemes are represented by the letters, f, s, sh, th, z, v, ch, and ge. The low reading group also experienced difficulty with the voiced affricate-fricative and voiceless affricate-fricative comparisons. From observations made during the testing sessions, children often mistakenly identified ch-sh and s-sh as being the same as in cherry-sherry or lease-leash.

Table XVIII compares the performance of high and low reading achievers on ability to hear voiced and voiceless sound type contrasts and the ability to visually discriminate letters representing voiced or voiceless sound types.

The comparative results show that in all cases, with the exception of voiced stop-stop comparisons, the auditory task was more difficult for the high reading achievement group. The low reading achievement group, however, found it harder to auditorily discriminate voiced stop-stop comparisons than to visually discriminate letters representing voiced stop-stop comparisons. When children auditorily discriminate

TABLE XVIII

COMPARISON OF DIFFICULTY LEVELS OF VOICED AND VOICELESS SOUND TYPES TESTED ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST AND LETTERS REPRESENTING THESE SOUNDS ON THE VISUAL TEST BY READING ACHIEVEMENT GROUPS

Voicing	Sound Type	Difficulty Index for Test Items On:			
		Auditory Discrimination Test		Visual Discrimination Test	
		High Reading Ach.	Low Reading Ach.	High Reading Ach.	Low Reading Ach.
Voiced	Stop-Stop	.825	.651	.844	.644
	Nasal-Nasal	.754	.592	.954	.755
	Semivowel-Lateral	.884	.729	.971	.871
	Fricative-Fricative	.682	.522	.981	.775
	Fricative-Affricate	.728	.485	.971	.667
	Fricative-Stop	.784	.586	.980	.860
Voiceless	Stop-Stop	.773	.542	.955	.757
	Fricative-Fricative	.857	.666	.948	.760
	Fricative-Affricate	.800	.507	.948	.711
	Fricative-Stop	.787	.583	.991	.820

word pairs such as web-wed each sound is produced within a time sequence. The child has the opportunity to hear each sound in its correct sequence only once. When web-wed is presented visually the child may also encounter difficulties although it is an easier task because the child has the opportunity to view each letter many times. This may cause the child to confuse the sequence of letters or alter the spatial position of some of the letters.

Table XIX summarizes the mean, percentage of difference between the means, standard deviation and t-test results of high and low achievers to discriminate letters representing voiced and voiceless sounds.

T-test results indicate significant differences between ability of high and low reading achievers to discriminate voiced and voiceless sounds represented by letters. Only small differences exist within the high reading achievement group and the low reading achievement group to visually discriminate letters representing voiced or voiceless sounds.

Performance of High and Low Reading Achievers by Position of Letters Representing Sounds

Table XX indicates the difficulty index levels on specific sound types represented by letters on the *Visual Test*.

Both high and low reading achievement groups found the initial stops-fricative comparisons and semivowel-lateral comparisons the easiest to visually discriminate. The most difficult letters representing sound category for the low

TABLE XIX

MEANS, STANDARD DEVIATIONS, AND T-TEST RESULTS OF HIGH AND LOW READING ACHIEVERS ON LETTERS REPRESENTING VOICED AND VOICELESS SOUNDS

Voicing	No.of Items	High Rdg. Achievers			Low Rdg. Achievers			"T"-Score	
		Mean	Mean % Diff.	S.D.	Mean	Mean % Diff.	S.D.		
Voiced Sounds	67	63.93	4.6	3.02	53.67	19.9	9.41	5.592	**
Voiceless Sounds	66	63.13	4.3	3.80	53.20	19.2	10.76	4.642	**

** Significant at .01 level of confidence when t-score reaches 2.66

* Significant at .05 level of confidence when t-score reaches 2.00

TABLE XX

DIFFICULTY LEVELS OF READING ACHIEVEMENT GROUPS ON POSITION OF SPECIFIC SOUND TYPES TESTED ON THE VISUAL TEST

Sound Type	Group	No. of Items	Initial	No. of Items	Medial	No. of Items	Final
Stop-Stop	High	0	---	6	.966	18	.896
	Low		---		.724		.745
Nasal-Nasal	High	0	---	5	.940	6	.966
	Low		---		.641		.850
Semivowel-Lateral	High	9	.992	2	.950	0	---
	Low		.915		.672		---
Fricative-Fricative	High	15	.966	13	.943	20	.956
	Low		.882		.689		.829
Affricate-Fricative	High	3	.977	7	.928	6	.977
	Low		.896		.610		.827
Fricative-Stop	High	12	.997	0	---	11	.969
	Low		.910		---		.833

reading achievement group to visually discriminate was medial affricate-fricatives. Only 61 percent responded correctly to items in this category. Such word pairs as switches-swishes, and lesion-legion were often incorrectly identified as being the same. The high reading achievement group experienced some difficulty with letters representing stop-stop comparisons in the final position. The web-wed comparison was often mistaken as being similar.

Table XXI compares the performance of high and low achievers on the position of sounds on the Fast-Cosens Auditory Discrimination Test and letters representing sound types on the Visual Test.

Comparative results show that low reading achievers found it easier to auditorily discriminate sounds in the semivowel-lateral category than to visually discriminate letters representing these sounds. The phonological environment auditorily may make this an easier task while the transitory nature of the visual task may confuse the child when letters are embedded in words.

The mean, percentage of difference between the means, standard deviation and t-test results for letters representing sounds in the initial, medial and final position are found in Table XXII.

The results indicate that there were significant differences between high and low reading achievers on ability to visually discriminate letters representing sound contrasts in the initial, medial and final position. Small differences

TABLE XXI

COMPARISON OF HIGH AND LOW READING ACHIEVERS SCORES BY POSITION OF SOUND ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST AND LETTERS REPRESENTING SOUNDS ON THE VISUAL TEST

Student Group	Sound Type Contrast	Difficulty Index Levels for: Auditory Discrimination Test Initial	Medial	Final	Visual Discrimination Test Initial	Medial	Final
High Reading Ach.	Stop-Stop	---	.766	.802	---	.966	.896
	Nasal-Nasal	---	.806	.711	---	.940	.966
	Semivowel-Lateral	.885	.866	---	.992	.950	---
	Fricative-Fricative	.693	.812	.805	.966	.943	.956
	Affricate-Fricative	.566	.800	.811	.977	.928	.977
	Fricative-Stop	.791	---	.778	.997	---	.969
Low Reading Ach.	Stop-Stop	---	.551	.593	---	.724	.745
	Nasal-Nasal	---	.627	.563	---	.641	.850
	Semivowel-Lateral	.739	.741	---	.915	.672	---
	Fricative-Fricative	.560	.612	.620	.882	.689	.829
	Affricate-Fricative	.367	.546	.517	.896	.610	.827
	Fricative-Stop	.623	---	.586	.910	---	.833

TABLE XXII

MEANS, STANDARD DEVIATION AND T-TEST RESULTS FOR HIGH AND LOW ACHIEVERS OF COMPARISONS AMONG LETTERS REPRESENTING SOUNDS IN THE INITIAL, MEDIAL, AND FINAL POSITIONS

Position of Sound	No. of Items	High Reading Achievers			Low Reading Achievers			"T"-Score	
		Mean	Mean % Diff.	S.D.	Mean	Mean % Diff.	S.D.		
Initial	80	79.17	1.03	1.24	75.20	6.0	5.28	3.937	**
Medial	66	64.07	2.9	2.53	54.43	17.4	8.34	5.954	**
Final	120	116.73	2.7	3.23	106.27	11.4	14.06	3.906	**

** Significant at .01 level of confidence when t-scores reach 2.66

* Significant at .05 level of confidence when t-scores reach 2.00

between each position were recorded within the high reading achievement group. Within the low reading achievement group larger mean differences were found between each position with letters representing sounds in the medial position being the most difficult. Sounds in the medial position were found to be the easiest position to discriminate as indicated by scores on the Fast-Cosens Auditory Discrimination Test. Letters representing sounds in the medial position were more difficult than any other position for low reading achievers to visually discriminate. A possible explanation may be that the letters representing sounds are embedded among other letters making visual discriminations of letters in the medial position a more difficult task.

Performance of High and Low Achievers on Like and Unlike Word Pairs on the Visual Discrimination Test

There were a total of 133 like and 133 unlike word pairs on the Visual Test. Table XXIII indicates the mean, standard deviation and t-test results for like and unlike word pairs.

Significant differences exist between mean test scores on like and unlike pairs. Seeing similarities between letters was easier than seeing differences between unlike word pairs.

Results show both the high and low achievement groups found it easier to discriminate similar word pairs. The mean for the high achievement group in discriminating like word pairs was 132.63 and the mean for discriminating unlike

TABLE XXIII

MEAN, STANDARD DEVIATION AND T-TEST RESULTS OF COMPARISONS AMONG LIKE AND UNLIKE WORD PAIRS ON THE VISUAL TEST

Word Pairs		High Reading Achievers			Low Reading Achievers			"T"-Score	
		Mean	Mean % Diff.	S.D.	Mean	Mean % Diff.	S.D.		
Like	(133)	132.63	.03	.55	128.93	3.1	14.80	1.345	
Unlike	(133)	127.20	2.9	6.25	106.97	4.5	19.68	5.276	**

** Significant at .01 level of confidence when t-score reaches 2.66

* Significant at .05 level of confidence when t-score reaches 2.00

word pairs was 127.20. The mean for the low reading achievement group in discriminating like word pairs was 128.93 and the mean for unlike word pairs is 106.97. The task of seeing differences between unlike word pairs was more difficult as was the task of hearing differences between unlike word pairs.

Summary

Table XXIV is a summary of the data obtained regarding sound type, voicing and position on the Fast-Cosens Auditory Discrimination Test and letters representing voiced or voiceless sound types and position on the Visual Test.

The performance by both the high and low achievement groups was at a much higher level on the Visual Test as compared to the Fast-Cosens Auditory Discrimination Test. The stops with fricative comparisons were the easiest for both groups to discriminate visually. The stop-stop category was the most difficult category for high achievers and the second most difficult category for low achievers to visually discriminate. The affricate-fricative category was the most difficult sound contrast for low reading achievers to visually discriminate. This same pattern of difficulty emerged when the Fast-Cosens Auditory Discrimination Test was analyzed for sound types. It appears that children who have difficulty hearing certain sound contrasts may also have difficulty seeing differences between these sound contrasts when represented by letters.

There was little difference within either the high and

TABLE XXIV

COMPARATIVE SUMMARY OF MOST DIFFICULT ITEMS CONSIDERING SOUND TYPE, VOICING AND POSITION BY HIGH AND LOW READING ACHIEVERS

Student Group	Most Diff. Items	Auditory Discrimination Test			Visual Discrimination Test		
		*Sound Type	**Voicing	***Position	Sound Type	Voicing	Position
High Reading Ach.	1	Nasal-Nasal	Vd.Fric-Fric.	In.Fric-Affr.	Stop-Stop	Vd.Stop-Stop	F.Stop-Stop
	2	Fric-Affr.	Vd.Fric-Affr.	In.Fric-Fric.	Nasal-Nasal	Vl.Fric-Fric	M.Affr-Fric
	3	Fric-Fric.	Vd.Nasal-Nasal	F. Nasal-Nasal	Fric-Fric.	Vl.Fric-Affr	M.Nasal-Nasal
	4	Fric-Stop	Vl.Stop-Stop	F.Stop-Stop	Fric-Affr.	Vd.Nasal-Nasal	F.Fric-Fric
Low Reading Ach.	1	Fric-Affr.	Vd.Fric-Affr.	In.Fric-Affr.	Affr.Fric.	Vd.Stop-Stop	M.Affr-Fric
	2	Stop-Stop	Vl.fric-Affr	F. Fric-Affr.	Stop-Stop	Vd.Fric-Affr.	M.Nasal-Nasal
	3	Nasal-Nasal	Vl.Stop-Stop	M.Fric-Affr.	Nasal-Nasal	Vl.Fric-Affr.	M.Semi-Lat.
	4	Fric-Fric.	Vd.Fric-Fric.	M.Stop-Stop	Fric-Fric.	Vd.Nasal-Nasal	M.Fric-Fric

* Fric. Fricative
Affr. Affricate
Semi. Semivowel
Lat. Lateral

** Vd. Voiced
Vl. Voiceless

*** In. Initial
M. Medial

low reading achievement groups to visually discriminate letters representing voiced and voiceless sounds. Significant differences were found between high and low reading achievers to visually discriminate letters representing voiced and voiceless sounds.

Letter differences in medial positions were hardest for both groups to visually discriminate. The initial sounds were hardest to discriminate auditorily while letters representing medial sounds were hardest to discriminate visually. The phonemic environment auditorily was considered to have an important role in making auditory discriminations difficult or easy. As in the auditory realm, unlike word pairs were harder to visually discriminate than like word pairs.

STUDENT PERFORMANCE ON THE AUDITORY-VISUAL CORRESPONDENCE TEST

The mean difficulty index level, the difference between the means, and the percentage of difference between the means were calculated for each of the sounds within the same sound type category for both reading achievement groups. Differences between mean scores for the high and low reading achievement groups were assessed using t-tests. Difficulty index levels were calculated for each auditory-visual correspondence tested. In addition, comparisons were made with pupil performance on the Fast-Cosens Auditory Discrimination Test and the Visual Test.

Total Performance of Test Sample: Auditory-Visual Correspondence

Figure 3 indicates the distribution of scores by high and low

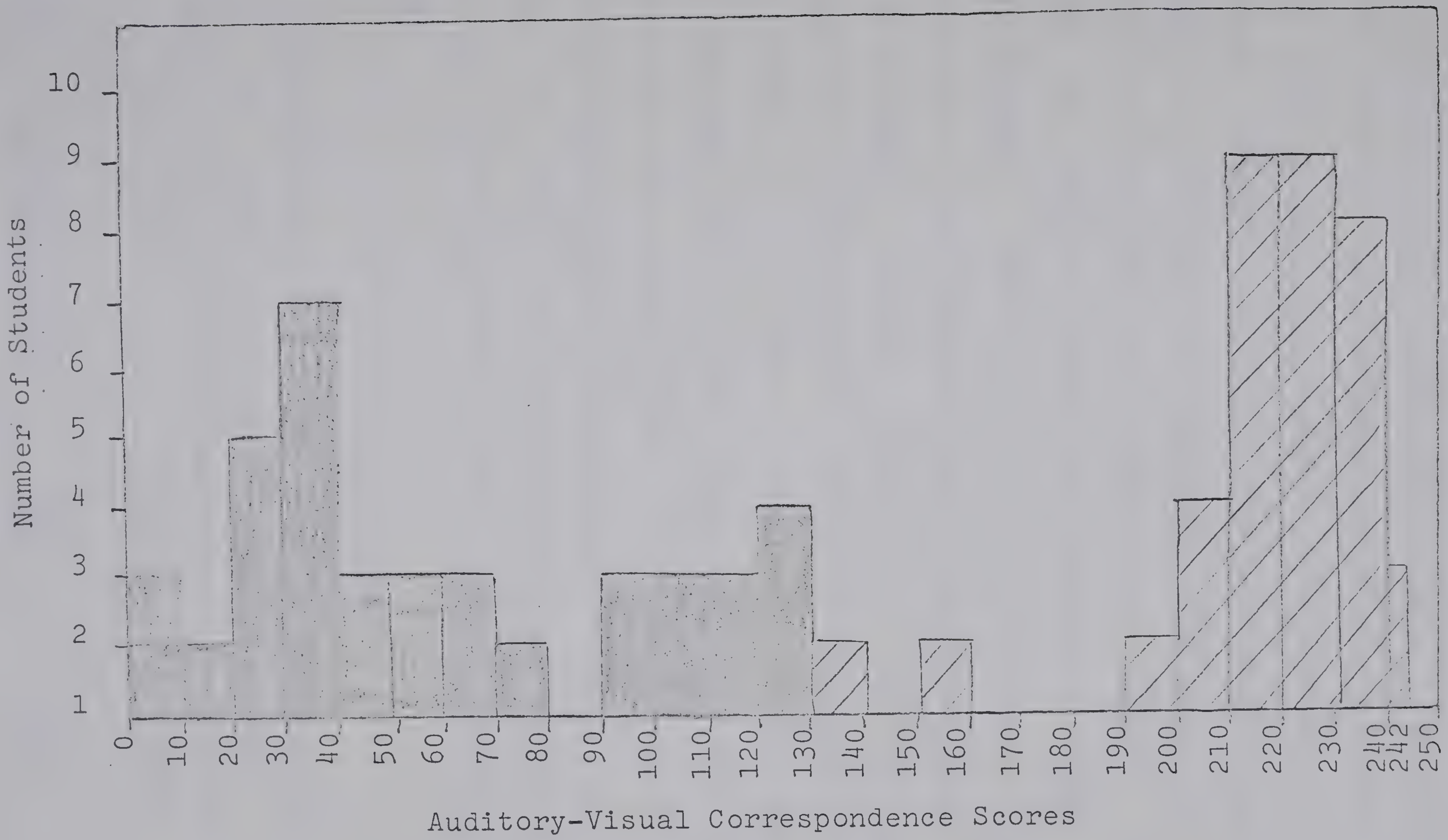


FIGURE 3

DISTRIBUTION OF SCORES FOR HIGH AND LOW READING ACHIEVERS ON THE AUDITORY-VISUAL CORRESPONDENCE TEST

▒ Low Reading Achievers ▨ High Reading Achievers

reading achievers on the Auditory-Visual Correspondence Test.

The distribution of test scores ranged from 0 - 242 on the Auditory-Visual Correspondence Test. The total possible score was 246. The distribution of scores clearly reveals that none of the low achievement group did as well as the child with the lowest score in the high achievement group. The range of scores for the high achievement group was 138 to 242, while the low achievement scores ranged from 0 - 130. The child was required to make both associations before any points were awarded. Had a score of one been given for each correct association, the scores by the low achievment group may have been altered. However, it was evident that the task of associating a phoneme with its printed representation was a most difficult task for all children in the low achievement group.

The mean for the high achievement group was 219.70 and the standard deviation was 20.99. The mean for the low achievement group was 59.93 with a standard deviation of 39.59. Table XXV presents the means and standard deviation of high and low reading achievers on the Auditory-Visual Correspondence Test.

TABLE XXV

PERFORMANCE OF SUBJECTS ON AUDITORY-VISUAL CORRESPONDENCE TEST BY READING ACHIEVEMENT GROUPS

Student Group	No. of Students	Test Mean 246/246	Standard Deviation
High Reading Achievers	30	219.70	20.99
Low Reading Achievers	30	59.93	39.59

Table XXVI summarizes the mean, percentage of difference between the means, and standard deviation for high and low achievers on the Fast-Cosens Auditory Discrimination Test, Visual Test, and Auditory-Visual Correspondence Test.

Comparative results for the low achievement group clearly indicate that the task of making auditory-visual correspondences was far more difficult than making auditory and visual discriminations of minimal word pairs. The order of difficulty experienced by the low achievement group appears to substantiate the premise that the ability to make auditory-visual correspondences is derived firstly from skill in making auditory discriminations between speech sounds.

The performance by the high reading achievement group, however, does not follow this same order of difficulty as one may expect. The task of making auditory-visual correspondences was easier than making auditory discriminations of minimal word pairs. Part of the explanation for this finding may be in the nature of the two tasks involved. In auditorily discriminating minimal word pairs the important time element was present. Many of the high achievement group knew the auditory-visual correspondences well, but had a time factor been introduced, the scores may certainly have been lower.

Performance of Total Test Sample on Auditory-Visual Correspondences Classified as Various Sound Types

The scores on the Auditory-Visual Correspondence Test were analyzed, in order to find which type of sounds were the

TABLE XXVI

COMPARISON PERFORMANCE OF SUBJECTS ON FAST-COSENS AUDITORY DISCRIMINATION TEST, VISUAL TEST AND AUDITORY-VISUAL CORRESPONDENCE TEST BY READING ACHIEVEMENT GROUPS

Student Group	No. of Students	Auditory Discrimination Test			Visual Test			Auditory-Visual Correspondence Test		
		Mean	Mean % Diff.	S.D.	Mean	Mean % Diff.	S.D.	Mean	Mean % Diff.	S.D.
High	30	226.13/266			259.83/266			219.70/246		
Reading			14.9			2.3			10.6	
Achievers				15.97			6.22			20.99
Low	30	201.30			234.47			59.93		
Reading			24.3			11.8			75.6	
Achievers				25.02			26.58			39.59

most difficult to verbalize. Only sounds among the same sound type category were used in calculating the difficulty index.

Difficulty in verbalizing sound types. Table XXVII indicates the proportion of students correctly making auditory-visual correspondences of sounds within the same sound type category. For example, the underlined letters in co*g*-co*b*, represent the same sound type category, stops. However, *v*an-*b*an represent two sound types, fricative and stop. The test was scored in such a manner that it was later impossible to note if the fricative or stop was incorrectly verbalized. In addition, the computer programs were not set up to accommodate 492 items had each phoneme been given a point. The investigator wanted as well, to retain the minimal word pairs form as in the auditory and visual tests. In order to accommodate some adjustments were made, but the test retained 213 of the original 246 test items.

The low achievement group performance on the *Auditory-Visual Correspondence Test* was poor. No more than 50 percent responded to items correctly in any category. With the exception of affricates and nasals the high achievement group's performance was at a high level.

The low achievement group found nasals and affricates the most difficult sound type to verbalize. The nasal /ŋ/ in words such as wi*ng* were difficult. Children in this school system used a reading series which did not stress this sound-symbol association and it was obvious that many children

TABLE XXVII

DIFFICULTY LEVELS OF TYPES OF SOUNDS TESTED ON THE AUDITORY-VISUAL CORRESPONDENCE TEST BY READING ACHIEVEMENT GROUPS

Sound Type	No. of Items	Reading Achievement Group	Mean Difficulty Index	Difference Between Means	% of difference Between Means
Stop-Stop	61	High	.958		
		Low	.379	.579	58
Nasal-Nasal	22	High	.672		
		Low	.132	.540	54
Semivowel-Semivowel	9	High	.996		
		Low	.496	.500	50
Lateral-Lateral	4	High	1.00		
		Low	.258	.742	74
Fricative-Fricative	112	High	.928		
		Low	.195	.733	73
Affricate-Affricate	5	High	.453		
		Low	.141	.312	31
	213				

had not made any generalizations from seeing this combination in familiar words in their readers. Affricate /ǰ/ as in page was often confused with /g/ as in bug. Only one student was aware of the vowel after g. Only 13 percent of the students responded correctly to items in nasal category while 14 percent responded correctly to items in the affricate category. In many cases the low reading achievers simply could not associate any of the sounds with any of the symbols.

The high achievement group also had difficulties verbalizing sounds in the affricate and nasal categories. Forty-five percent responded correctly to items in the affricate category and 67 percent responded correctly to items in the nasal category. Fricative comparisons proved to be the third in difficulty for both the high and low reading achievement groups. In many instances /θ/ and /ð/ as in thin and then respectively, were confused or the subject verbalized /t/ as in top for /θ/ or /ð/. Many were completely unaware that /θ/ and /ð/ although represented by more than one letter actually had only one sound.

The Table XXVIII summarizes the difficulty indexes that arise when all three tests are analyzed.

A close examination of Table XXVIII clearly shows that within the low reading achievement group in all sound type categories, the auditory-visual task was by far the most difficult, followed by the auditory and visual tasks respectively. This pattern is not consistent, however, within the high reading achievement group. The findings

TABLE XXVIII

DIFFICULTY LEVELS OF TYPES OF SOUNDS TESTED ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST, LETTER REPRESENTING SOUNDS ON THE VISUAL TEST, AND THE AUDITORY-VISUAL CORRESPONDENCE TEST

Student Group	Sound Type Contrast	Difficulty Index Level On: Auditory Discrimination Test	Visual Discrimination Test	Auditory-Visual Correspondence Test
High Reading Achievement	Stop-Stop	.793	.913	.958
	Nasal-Nasal	.754	.954	.672
	Semivowel-Lateral	.884	.971	---
	Fricative-Fricative	.772	.956	.928
	Affricate-Fricative	.768	.958	---
	Fricative-Stop	.784	.984	---
	Affricate-Affricate	---	---	.453
	Semivowel-Semivowel	---	---	.996
	Lateral-Lateral	---	---	1.00
Low Reading Ach.	Stop-Stop	.583	.739	.379
	Nasal-Nasal	.592	.755	.132
	Semi-vowel-Lateral	.792	.871	---
	Fricative-Fricative	.599	.807	.195
	Fricative-Affricate	.514	.715	---
	Fricative-Stop	.605	.875	---
	Affricate-Affricate	---	---	.141
	Semivowel-Semivowel	---	---	.496
	Lateral-Lateral	---	---	.258

within the stop-stop sound type category for example, appear to be contradictory. For the high reading achievement group it was easier to make sound-symbol associations involving stops (b, d, g, k, t, p) than to see these differences in minimal word pairs. Perhaps this can be explained by the fact that children in this study were exposed to (p) (b) and (t) as in Pony, Tom and Betty very early in the school year, and had by the end of the year ample opportunity to learn these associations. The lower difficulty index on stop-stop comparisons on the Visual Test may reflect the amount of attention given to (b) and (d) when these letters were not specifically pointed out as in the Auditory-Visual Correspondence Test.

For convenience the three most difficult sound types on all three tests are outlined in Table XXIX.

It appears that similar patterns of difficulty arise when sound type is maximized in all three tests. For example, the low reading achievement group experienced difficulty with fricative-affricate comparisons when presented orally. This same group also had difficulty visually discriminating letters which represent fricative-affricate comparisons, although their performance level was higher on the visual task.

When fricatives and affricates were singled out in words the low reading achievement group in many cases was unable to successfully verbalize the sounds represented by the letters.

The low reading achievement group also found stop-stop

TABLE XXIX

DIFFICULTY OF SOUND CONTRASTS BY HIGH AND LOW READING ACHIEVEMENT GROUPS ON THE FAST-COSENS AUDITORY DISCRIMINATION TEST, VISUAL TEST AND AUDITORY-VISUAL CORRESPONDENCE TEST

Achievement Group	Most Difficult Items	*Aud-Test	**Vis-Test	***A-V Test
High	1	Nasal-Nasal	Stop-Stop	Affricates
	2	Fricative-Affricate	Nasal-Nasal	Nasals
	3	Fricative-Fricative	Fricative-Fricative	Fricatives
Low	1	Fricative-Affricate	Fricative-Affricate	Nasals
	2	Stop-Stop	Stop-Stop	Affricates
	3	Nasal-Nasal	Nasal-Nasal	Fricatives

* Aud-Test Fast-Cosens Auditory Discrimination Test

** Vis-Test Visual Test

*** A-V Test Auditory-Visual Correspondence Test

comparisons difficult to discriminate auditorily and visually. Although stops did not appear as one of the three most difficult sound types to verbalize, it was nevertheless difficult as well. In comparison, nasals, affricates and fricatives were more difficult.

It should also be pointed out that the high reading achievement group also experienced difficulty with nasals and fricatives in all three cases. It is interesting to note, within the high reading achievement group that the visual discrimination of stop-stop comparisons was the most difficult. However, stop-stop comparisons were not among the most difficult categories to auditorily discriminate or verbalize. The low reading achievement group found this same category difficult. It appears then, that some special consideration should be given to letters which are easily reversed or rotated.

Table XXX indicates that highly significant differences exist between high and low achievers in ability to verbalize sounds represented by letters in any sound category.

The t-test results indicate that the high reading achievement group possess superior ability to verbalize sounds represented by letters as compared to the performance scores attained by the low reading achievement group among any sound type category. The inadequate ability of low reading achievers to verbalize sounds represented by letters may be attributed in part to their inaccurate discrimination of sounds in words and their inattention to details and orientation

TABLE XXX

MEANS, STANDARD DEVIATIONS AND T-TEST RESULTS FOR HIGH AND LOW ACHIEVERS ON TOTAL AUDITORY-VISUAL CORRESPONDENCE TEST AND SOUND TYPES

Scores	No.Test Items Possible	High Achievers		Low Achievers		"T"-Score	Prob.2
		Means	S. Dev.	Means	S. Dev.		
Total	246	219.70	20.99	59.93	39.59	19.04 **	.0000
Semivowels	9	8.97	0.18	4.39	3.12	7.874 **	.0000
Stops	61	57.90	2.68	21.21	16.36	11.899 **	.0000
Nasals	22	15.57	6.71	3.54	2.23	8.875 **	.0000
Fricatives	112	97.20	13.08	24.04	16.67	18.335 **	.0000
Laterals	4	3.90	0.30	1.32	1.75	7.792 **	.0000
Affricate	5	3.27	1.63	0.61	1.26	6.787 **	.0000

** Significant at .01 level of confidence for a two-tailed test when t-score reaches 2.66

* Significant at .05 level of confidence for a two-tailed test when t-score reaches 2.00

of letters. The fact that auditory discrimination and visual discrimination skills are necessary in learning to read are not to be disputed. The ability to associate or integrate what the child sees in print with what he hears in speech is also a very important factor which must be considered. Birch and Belmont (1965:304) point out that the ability to integrate visual and auditory stimuli is developmental and that this development is being established during the first school years. Perhaps the poorer scores obtained by the low reading achievement group indicate that their discriminative ability and their integrative ability has not yet developed to the extent that it has developed in children high in reading achievement.

Difficulty Verbalizing Individual Consonant Speech Sounds

Each sound type was then analyzed by finding the number of correct responses made to any one phoneme in each category. Only those word pairs which were alike or within the same sound type category were used for this analysis. Table XXXI indicates the difficulty levels of each phoneme according to sound type in the high and low achievement groups.

Examination of the table reveals that children in the low reading group experienced many difficulties with particular phonemes. The /ŋ/ in ring was difficult for both groups. Special attention is often given to the inflectional ending ing and children often verbalized ing for /ŋ/ or produced /n/ and /g/ instead. The /b/ and /d/ were difficult phonemes for the low reading achievement group, probably because (b)

TABLE XXXI

DIFFICULTY OF PHONEMES ON AUDITORY-VISUAL CORRESPONDENCE TEST BY PUPIL READING ACHIEVEMENT GROUPS

Sound Type	Phoneme	No. of Items	Example	High Reading Achievers Diff. Index	Low Reading Achievers Diff. Index
Nasals	/m/	4	swim	.983	.458
	/n/	2	thin	.966	.416
	/ŋ/	5	ring	.620	.006
Stops	/k/	4	shake	.983	.667
	/p/	10	sheep	.983	.460
	/t/	5	boat	1.00	.446
	/d/	10	dare	.983	.227
	/b/	5	boat	.986	.346
	/g/	3	cog	.622	.200
Affricates	/ǰ/	4	page	.341	.141
	/č/	1	chin	.900	.000
Fricatives	/s/	15	mouse	.988	.631
	/θ/	10	thin	.890	.002
	/ð/	6	then	.927	.333
	/s/	16	wish	.944	.075
	/f/	6	fence	.983	.588
	/v/	6	van	.972	.166
	/ž/	4	azure	.525	.408
Semivowel-Laterals	/w/	2	win	1.00	.400
	/r/	4	ring	.991	.675
	/l/	4	feel	1.00	.258

and (d) are easily reversed and rotated. Performance by both achievement groups was poor on /g / and /ǰ/. Children were completely unaware that the e after g as in page serves as a signaling device for the proper pronunciation of /ǰ/ . Children were therefore confused about the two sounds which can be presented by the letter g. Fricatives /ś, ∂ , θ and v/ were also difficult for low reading achievers. It appeared that these children were unaware, although these sounds were represented by two letters, that it was only one sound. Interestingly, none of the low reading achievement group could verbalize /č/ as in chin or cherry when their basic reader is called *On Cherry Street*.

Although all children in this study were exposed to the same reading materials, the high reading achievement group were better able to associate certain sounds with their appropriate symbols.

For the readers convenience, the ten most difficult phonemes to verbalize for each achievement group are summarized in Table XXXII.

The difficulty index range of the ten most difficult phonemes was .341 to .972 among the high reading achievement group and .000 to .333 among the low reading achievement group. Eight of the ten most difficult phonemes to verbalize were common to both reading achievement groups. The phonemes /d/ and /l/ which the low reading achievement group found difficult to verbalize were not among the tem most difficult items for the high achievement group. The phoneme /ž/ and

TABLE XXXII

SUMMARY OF TEN MOST DIFFICULT PHONEMES ON THE AUDITORY-VISUAL CORRESPONDENCE TEST

High Achievement Group			Low Achievement Group		
Phoneme	Letters Rep. Phoneme	Difficulty Level	Phoneme	Letters Rep. Phoneme	Difficulty Level
/ǰ/	(g)	.341	/č/	(ch)	.000
/ž/		.525	/θ/	(th)	.002
/ŋ/	(ng)	.620	/ŋ/	(ng)	.006
/g/	(g)	.622	/š/	(sh)	.075
/θ/	(th)	.890	/ǰ/		.141
/č/	(ch)	.900	/v/	(v)	.161
/ð/	(th)	.927	/g/	(g)	.200
/š/	(sh)	.944	/d/	(d)	.227
/n/	(n)	.966	/l/	(l)	.258
/v/	(v)	.972	/ð/	(th)	.333
			/ž/		.408
			/n/	(n)	.416

and /n/ which the high reading achievement group found difficult to verbalize were not among the ten most difficult for the low reading group. The phonemes /ž/ and /n/ however, with difficulty indexes of .408 and .416 respectively, were nevertheless difficult to verbalize but the low reading achievement group had so many other difficulties that /ž/ and /n/ were not listed among the ten most difficult phonemes.

The findings also reveal that all of six phonemes represented by two letters, /ð, θ, č, š, ŋ, and ǰ/ were among those which were hardest to make the appropriate verbalization. The investigator noted that in many instances children in the low reading achievement group were completely unaware that two letters did represent only one sound. Often, for example, /š/ was pronounced as /s/. Children also had difficulty distinguishing letters (b) from (p) or (d), (t) from (f) and (m) from (w).

Children experienced the greatest difficulty with sounds represented by two letters. It appears that had the sounds represented by three letters been included in the _Auditory-Visual Correspondence Test_ they would have experienced much more difficulty.

Summary

Findings revealed that the low reading achievement group found the task of making auditory-visual correspondences the most difficult followed by auditory discriminations and visual discriminations. The high reading achievement group, however, found that making auditory discriminations were the most

difficult task. Significant differences were found between high and low reading achievers on auditory discrimination scores, visual discrimination scores and auditory-visual correspondence scores.

Difficulty index levels revealed that both achievement groups experienced difficulty in verbalizing affricates, nasals, and fricatives. Children in both achievement groups also had difficulty making auditory discriminations among these same sound types. On the Visual Test children in both groups had difficulty seeing differences between letters representing affricates, nasals, and fricatives. Similar patterns of difficulty emerged when sound type was considered minimizing voicing and position. It appears that there may be a relationship between the child's auditory discrimination ability and visual discrimination ability and their ability to associate a sound with a letter. Again children in the high reading achievement group performed significantly better on all types of sound contrasts than did those children in the low reading' achievement group.

The Auditory-Visual Correspondence Test was analyzed and findings indicated highly significant differences between high and low reading achievers to make auditory-visual correspondences. Performance by the low reading achievement group was very poor. Both reading achievement groups found nasals and affricates among the most difficult consonants to verbalize. When phonemes were analyzed individually and placed in order of difficulty, six of the phonemes represented by two or more

letters were among the ten most difficult phonemes to verbalize.

It appears that the child's ability to make sound symbol associations is dependent to some extent on their discrimination ability. Although the percentage of difference between mean scores on the auditory discrimination and visual discrimination test among high and low reading achievers showed a near equal gain the high reading achievers were better able to make auditory-visual correspondences. Perhaps the high reading achievement group's better performance may be attributed to earlier development of perceptual abilities and the transfer of this discrimination ability from auditory to visual and visual to auditory.

CORRELATION OF VARIABLES

This section will discuss the correlations between the independent variables: chronological age, sex, intelligence and the three criterion variables: auditory discrimination scores, visual discrimination scores and auditory-visual correspondence scores. Correlation coefficients were computed for the high and low reading achievement group as well as for the total test sample.

Correlations Between Criterion Variables and Independent Variables

The correlation coefficient is a value used to represent the extent to which changes in one variable are accompanied by changes in another. Table XXXIII presents the correlation coefficients between chronological age, sex, and intelligence

TABLE XXXIII

CORRELATION OF SEX, CHRONOLOGICAL AGE AND I.Q. WITH CRITERION VARIABLES

Student Group	Correlation of Sex with			Correlation of Chronological Age with			Correlation of I.Q with		
	!Aud.	ØVis.	⌿A-V	Aud.	Vis.	A-V	Aud.	Vis.	A-V
High Achievers N = 30	.236	.161	.198	-.004	.141	-.050	-.004	.026	.184
Low Achievers N = 30	-.215	-.207	.004	-.295	.234	-.259	-.546**	-.118	.018
Total N = 60	-.097	-.006	-.036	.200	.181	.203	-.194	-.038	-.092

!Aud. - Auditory Discrimination Scores

ØVis. - Visual Discrimination Scores

⌿A-V - Auditory-Visual Correspondence Scores

** Significant at .01 level of confidence (when N = 30) = .449
(" N = 60) = .325

* Significant at .05 level of confidence (when N = 30) = .349
(" N = 60) = .250

with auditory discrimination scores, visual discrimination scores and auditory-visual correspondence scores.

No significant correlations were found between the independent variable sex or chronological age and auditory discrimination scores, visual discrimination scores and auditory-visual discrimination scores in high or low reading achievement groups or in the total group. Fast (1968:123) also found no correlation of each of sex, intelligence or age was significant with auditory discrimination.

When intelligence was correlated with auditory discrimination a significant negative relationship exists among low reading achievers. This appears to indicate that as intelligence increases, auditory discrimination ability decreases in the low achievement group. Perhaps the attention factor as well as intelligence influences auditory discrimination and results in a negative relationship. Oberg (1969) failed to find significant correlations between intelligence and auditory discrimination in grade one, and only when Fast (1968) considered the total sample was intelligence significantly related.

Summary

No significant correlations were found between age, sex and intelligence and visual discrimination scores or auditory-visual correspondence scores. The only significant correlation was intelligence with auditory discrimination among low reading achievers.

CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

This chapter will present a brief summary of the study and the main findings. Conclusions will then be drawn from the findings of the study and implications of these discussed. Suggestions for further research studies will be made.

SUMMARY OF THE STUDY

The ability to make auditory-visual correspondences has been recognized as an essential skill in achieving independence in reading. This study attempted to indicate whether there were differences between high and low reading achievement groups in their abilities to make auditory and visual discriminations and auditory-visual correspondences. It also attempted to indicate the relationship of these three abilities.

The test sample consisted of sixty first grade children who had been screened for reading achievement as well as auditory and visual acuity. An intelligence test was administered to each child. Information on the sex, and chronological ages of each was taken from the cumulative school records.

The *Fast-Cosens Auditory Discrimination Test* and the *Visual Test* measured auditory and visual discrimination respectively. The *Auditory-Visual Correspondence Test* measured the child's ability to verbalize speech sounds selected to correspond with those tested in the auditory and visual discrimination tests.

SUMMARY OF MAIN FINDINGS

The findings with respect to each hypothesis are as follows:

Null Hypothesis 1

1. There will be no significant difference in ability of high and low achievers in reading to make auditory discriminations among:
    - a. sound contrasts
        - I. stop-stop comparisons
        - II. nasal-nasal comparisons
        - III. semivowel-lateral comparisons
        - IV. fricative-fricative comparisons
        - V. affricate-fricative comparisons
        - VI. fricative-stop comparisons
    - b. voiced and voiceless sounds
    - c. sounds in initial, medial, and final positions
    - d. like and unlike word pairs

    as indicated by their scores on the Fast-Cosens Auditory Discrimination Test.

Null Hypothesis 1(a). An analysis of the student scores of the Fast-Cosens Auditory Discrimination Test reveals that there were significant differences, at the .01 level of confidence, between high and low reading achievers in ability to auditorily discriminate all sound type contrasts, with the exception of semivowel-lateral comparisons which reached the .05 level of confidence. Therefore, Hypothesis 1(a) was rejected.

Null Hypothesis 1(b). In auditorily discriminating voiced and voiceless sounds, there was a significant difference at the .01 level of confidence, between the scores of high and low reading achievers. Therefore Hypothesis 1(b)was rejected. Only small mean differences were found within the high and low reading achievement groups to discriminate voiced or voiceless sounds and therefore voiced sounds were considered equally difficult to discriminate with voiceless sounds.

Null Hypothesis 1(c). The mean test scores on sounds in the initial, medial, and final position for the high reading achievement group were significantly better than the mean test scores obtained by the low reading achievement group at the .01 level of confidence. Therefore, Hypothesis 1(c)was rejected. Sounds in the initial position were hardest for both reading achievement groups to auditorily discriminate and medial sounds were the easiest.

Null Hypothesis 1(d). There was a significant difference between the scores of high and low reading achievement groups on auditory discrimination of only unlike word pairs. Discrimination on like pairs failed to reach significant levels. Therefore Hypothesis 1(d), in part, was rejected.

Null Hypothesis 2

2. There will be no significant differences in ability of high and low achievers in reading to make visual discriminations among:

a. letters representing sound contrasts:
   - I. stop-stop comparisons
   - II. nasal-nasal comparisons
   - III. semivowel-lateral comparisons
   - IV. fricative-fricative comparisons
   - V. fricative-affricate comparisons
   - VI. fricative-stop comparisons

b. letters representing voiced and voiceless sounds

c. letters representing sound contrasts in initial, medial and final positions

d. like and unlike word pairs

as indicated by their scores on the visual counterpart of the Fast-Cosens Auditory Discrimination Test.

Null Hypothesis 2(a). Findings reveal that significant differences at the .01 level of confidence exist between ability of high and low reading achievement groups to visually discriminate letters representing all sound types. On the basis of this evidence Hypothesis 2(a)was rejected. The low reading achievement group found the affricate-fricative comparisons the most difficult category to visually discriminate. The stop-stop comparisons were the most difficult category for the high reading achievement group and the second most difficult for the low reading achievement group to visually discriminate.

Null Hypothesis 2(b). Significant differences were found at the .01 level of confidence between high and low reading achievers to discriminate letters representing voiced or

voiceless sounds. Hypothesis 2(b) is therefore rejected.

Null Hypothesis 2(c). Significant differences at the .01 level of confidence exist between the ability of high and low reading achievers to visually discriminate letters, representing all sound types, in the initial, medial and final position. Therefore, Hypothesis 2(c)was rejected. Sound types represented by letters in the initial position were easiest to discriminate. Both achievement groups found sound types in the medial position the most difficult to discriminate.

Null Hypothesis 2(d). When like and unlike word pairs were considered, significant differences exist at the .01 level of confidence between the ability of high and low reading achievers to visually discriminate unlike word pairs. Discrimination of like word pairs was found to be the easier task and no significant differences between ability of high and low reading achievers in visually discriminating like word pairs was found. Therefore, Hypothesis 2(d)was in part rejected.

Null Hypothesis 3

There will be no significant difference in ability of high and low achievers in reading to make auditory-visual correspondences of sounds of the same type when the two sounds are classified as:

I. stops
II. nasals
III. semivowels

IV. fricatives

V. affricates

VI. laterals

as indicated by their scores on the Auditory-Visual Correspondence Test.

Findings indicate that highly significant differences exist at the .01 level of confidence in ability of children high in reading achievement and children low in reading achievement to verbalize the sounds represented by letters and then classified into sound types. Performance scores by children in the high reading achievement group were significantly better in any sound category than those performance scores of the low reading achievement group. Therefore, Hypothesis 3 was rejected.

Null Hypothesis 4

There will be no significant correlation between age, sex, and intelligence of high and low achievers and:

a. auditory discrimination scores on the Fast-Cosens Auditory Discrimination Test.

b. visual discrimination scores on the visual counterpart of the Fast-Cosens Auditory Discrimination Test.

c. auditory-visual correspondence scores on the Auditory-Visual Correspondence Test.

Null Hypothesis 4(a). Sex and chronological age were not significantly correlated with auditory discrimination scores in either reading achievement group. Intelligence was significantly negatively related to auditory discrimination

scores at the .01 level of confidence within the low reading achievement group. Therefore, Hypothesis 4(a) in part was rejected.

Null Hypothesis 4(b). No significant correlations between sex, chronological age and intelligence with visual discrimination scores was found within either reading achievement group. Therefore, Hypothesis 4(b) was accepted.

Null Hypothesis 4(c). No significant correlations between sex, chronological age or intelligence with auditory-visual correspondence scores was found. Therefore Hypothesis 4(c) was accepted.

CONCLUSIONS OF THE STUDY

The following conclusions are drawn on the basis of findings reported in Chapter IV, and are generalized only to similar populations using similar testing instruments.

1. Additional training in auditory and visual discrimination is needed by both high and low reading achievement groups. In particular, those children low in reading achievement cannot be expected to make sound-symbol associations until their fundamental difficulties in auditory and visual discrimination are diagnosed and corrected. Children in high reading groups also need auditory training and visual training in letters representing stops.

2. The ability to make auditory discriminations, visual discriminations, and auditory-visual correspondences are highly skilled activities. By the end of grade one, many children are still experiencing difficulty with all three operations

although the degree of difficulty was greater for low reading achievers than for high reading achievers.

3. This study provides additional information on the difficulties children encounter in discriminating and integrating auditory and visual information, and warrants consideration of reading personnel when implementing reading readiness programs.

4. The development of auditory discrimination is facilitated or made more difficult by such features as the specific sound type, its voicing, or the position the sound has within a word.

5. The position of contrasting letters in words and the specific sound type the letters represent influence the ease or difficulty of development in visual discrimination.

6. The number of letters which represent one sound or the number of sounds represented by one letter, in part, make the development of sound-symbol associations an easier or more difficult task. Children found the most difficult phonemes were represented by two letters, for example, sh, th, and ch. The letter g can represent two different sounds and is often confused by the child.

7. None of the vaiables, sex, chronological age, or intelligence will influence ability to make auditory discriminations, visual discriminations, or auditory-visual correspondences, using similar testing instruments in similar testing situations.

IMPLICATIONS

The following have been drawn from the conclusions of

this investigation.

1. Reading personnel should realize that auditory and visual discrimination are developmental processes and children at the grade one level differ in their discrimination ability. Testing materials should be made available so teachers may assess the weaknesses and strengths of any group of children and plan an auditory and visual discrimination program accordingly.

2. Information is now available concerning the difficulties children encounter in making auditory discriminations, visual discriminations, and auditory-visual correspondences.

(a) Teacher should know that children find certain sound types more difficult to discriminate than others, and that its voicing and position affect discriminability. Auditory programs which focus on the child's difficulties will no doubt aid him in associating these sounds with their appropriate symbol.

(b) A visual discrimination program should concentrate on the discrimination of unlike word pairs, as it was found to be much more difficult than discrimination of like word pairs. Letters embedded in word pairs are also more difficult than if letter contrasts come at the beginning or end of words. Special consideration should be given to letters which could be rotated and reversed as they were difficult for each group to discriminate.

3. More emphasis could be placed on presenting the visual and auditory stimulus simultaneously in order to establish

auditory-visual correspodences. Perhaps many of the readiness materials could be prepared so the child had to write or feel a letter as it was being spoken. Not all children are capable of generalizing from familiar words in their readers that certain sounds and letters are associated unless they are specifically taught these associations.

4. Teachers should be alerted to the difficulties children encounter when associating a sound which is represented by two letters. These sounds which are represented by two letters are also among the most difficult for all first grade children to auditorily discriminate. Reading programs which strongly emphasize a decoding approach may be beyond the capabilities of many children in a heterogeneous first grade classroom.

RECOMMENDATIONS FOR FURTHER RESEARCH

1. A similar study which controlled the time in presenting each item on the Visual Test and Auditory-Visual Correspondence Test may be undertaken to see if the same patterns of difficulty emerge.

2. The present study investigated difference between high and low reading achievers to make auditory discriminations, visual discriminations and auditory-visual correspondences. A further study could involve only low reading achievement groups and assess their abilities within the group.

3. A further study might incorporate an auditory and visual discrimination training program and assess its effect on ability to make auditory-visual correspondences.

4. A study which investigates the development of auditory-visual correspondence in primary school children could outline the difficulties children encounter at successive grade levels.

5. A further study might investigate the relationship between auditory acuity and ability to make auditory-visual correspondences. The present study seems to indicate that many high reading achievers have inadequate auditory acuity but nevertheless are good readers.

6. The present study investigated the child's ability to make auditory discriminations, visual discriminations, and auditory-visual correspondences. A further study might investigate the relationship between these three abilities and reading achievement in first grade.

CONCLUDING STATEMENT

This study investigated the ability of high and low reading achievers to make auditory discriminations between minimal word pairs, to make visual discriminations between these same word pairs, and to verbalize the same minimal sound-contrasts represented by only one or two letters. It also attempted to ascertain any relationship between auditory and visual discrimination ability and ability to make auditory-visual correspondences.

The findings of the study indicated that in every case, the high reading achievement group performed significantly better than the low reading achievement group. Skill in making auditory and visual discriminations appears to be

directly related to success in making auditory-visual correspondences.

BIBLIOGRAPHY

A. BOOKS

Bloomfield, L. and C. Barnhart, Let's Read. Detroit: Wayne State University Press, 1961.

Buros, I.K., The Fifth Mental Measurement Yearbook. New Jersey: Gryphon Press, 1959.

Dechant, E., Improving the Teaching of Reading. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964.

Ferguson, G.A., Statistical Analysis in Psychology and Education. Toronto: McGraw-Hill, 1959.

Francis, N., The Structure of American English. New York: The Ronald Press Company, 1958.

Fries, C., Linguistics and Reading. New York: Holt, Rinehart and Winston, Inc., 1963.

Gleason, H.A., An Introduction to Descriptive Linguistics. New York: Holt, Rinehart and Winston, Inc., 1961.

Gray, W.S., On Their Own in Reading. Chicago: Scott, Foresman and Company, 1948.

Harris, A.J., Effective Teaching of Reading. New York: David McKay Company, Inc., 1962.

McKee, P., Reading. Boston: Houghton Mifflin Company, 1966.

Monroe, M., Children Who Cannot Read. Chicago: The University of Chicago Press, 1932.

Myklebust, H., The Psychology of Deafness. New York: Grune and Stratton, 1964.

Russell, D., Children Learn to Read. New York: Ginn and Company, 1961.

Smith, N.B., Reading Instruction for Today's Children. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1963.

Vernon, M.D., The Psychology of Perception. Great Britain: C. Nicholls and Company Ltd., 1962.

B. PERIODICALS

Ayres, J.A. "Reading - a Product of Sensory Integrative Processes", Perception and Reading. pp. 77-82.

Twelfth Annual Convention of the International Reading Conference. Newark: International Reading Association, Inc. 1968.

Barrett, T. "Visual Discrimination Tasks as Predictors of First Grade Reading Achievement," Reading Teacher, 18, 1965, pp.276-282.

Berry, J. "Matching of Auditory and Visual Stimuli by Average and Retarded Readers," Child Development, 38, 1967, pp. 827-833.

Birch, H., L. Belmont. "Auditory Visual Integration, Intelligence and Reading Ability in School Children," Perceptual and Motor Skills, 20, 1965, pp.295-305.

_______________________, "Auditory-Visual Integration in Normal and Retarded Readers," American Journal of Orthopsychiatry, 34, 1964, pp.852-861.

Blank, M. "Cognitive Processes in Auditory Discrimination in Normal and Retarded Readers," Child Development, 39, 1968, pp.1091-1101.

Buswell, Guy T. "The Process of Reading," The Reading Teacher, 13, December 1959, pp.108-114.

Carroll, J.B. "Language Development," Encyclopedia of Educational Research, ed. Chester W. Harris, 1960, pp.744-762.

Durrell, D. "First Grade Reading Success: A Summary," Journal of Education, Boston University, 140, February 1958, pp.2-6.

___________, and H. Murphy. "The Auditory Discrimination Factor in Reading Readiness and Reading Disability," Education, 73, May 1953, pp.556-560.

___________, "Learning Difficulties Among Children of Normal Intelligence," Elementary School Journal, 55, December 1954, pp.201-208.

Dykstra, R. "Auditory Discrimination and Beginning Reading," Reading Research Quarterly, Spring 1966, 4-33.

Gavel, S. "June Reading Achievements of First Grade Children," Journal of Education, Boston University, 140, February 1958, pp.37-43.

Gibson, E. "Learning to Read," Science, 148, May 1965, pp.1066-1072.

Gibson, E., H. Osser, and A. Pick. "A Study of the Development of Grapheme-Phoneme Correspondences," Journal of Verbal Learning and Verbal Behavior, 2, 1963, pp.142-146.

________. "Development of Perception: Discrimination of Depth Compared with Discrimination of Graphic Symbols," Basic Cognitive Processes in Children, Monograph of Society for Research in Child Development, Child Development Publications, Vol.28, No.2, 1963.

Goins, J. "Visual Perceptual Abilities and Early Reading Progress," Supplementary Educational Monographs, No.87, February,1958, University of Chicago Press.

Goodman, K. "The Linguistics of Reading." Elementary School Journal, Vol.64, April, 1964, pp.355-361.

Gorelick, M. "The Effectiveness of Visual Form Training in a Pre-Reading Program," Journal of Educational Research,58, March, 1965, pp.315-318.

Gray, W.S. "The Major Aspects of Reading," Sequential Development of Reading Abilities, pp. Supplementary Educational Monographs, No.90, Chicago: University of Chicago Press, 1960.

Harrington, M.J. and D. Durrell. "Mental Maturity Versus Perceptual Abilities in Primary Reading," Journal of Educational Psychology, 46, October, 1955, pp.375-380.

Jaranko, A. "Danger Points in Reading Instruction," Reading Teacher, 22, March, 1969, pp.507-509.

Kahn, D. "The Development of Auditory Visual Integration and Reading Achievement," Doctoral Dissertation Abstract, Vol 26, 1965, p.2589.

Katz, P., M. Deutsch. "Relation of Auditory-Visual Shifting to Reading Achievement," Perceptual Motor Skills, October, 1963, pp.327-332.

King, E.M. "Effects of Different Kinds of Visual Discrimination Training on Learning to Read Words," Journal of Educational Psychology, 55, November, 1964, pp.325-333.

Meuhl, S. "The Effects of Letter Name Knowledge on Learning to Read a Word List in Kindergarten Children," Journal of Educational Psychology, 53, 1962, pp.181-186.

________. "The Effects of Visual Discrimination Pretraining With Word and Letter Stimuli on Learning to Read a Word List in Kindergarten Children," Journal of Educational Psychology, 52, 1961, pp.215-221.

Meuhl, S. "The Effects of Visual Discrimination Pretraining on Learning to Read a Vocabulary List in Kindergarten Children," Journal of Educational Psychology, 51(4), 1960, pp.217-221.

_______, and S. Kremenak. "Ability to Match Information within and Between Auditory and Visual Sense Modalities and Subsequent Reading Achievement," Journal of Educational Psychology, 57, 1966, pp.230-239.

Miller, G. and P. Nicely. "An Analysis of Perceptual Confusions Among Some English Consonants," Psycholinguistics: A Book of Reading, S. Saporta, editor, New York: Holt Rinehart and Winston, 1966, pp.153-175.

Nickolson, A. "Background Abilities Related to Reading Success in First Grade," Journal of Education, Boston University, 140, February, 1958, pp.7-24.

Olson, A. "Growth in Word Perception Abilities as it Relates to Success in Beginning Reading," Journal of Education, Boston University, 140, February, 1958, pp.25-36.

Poling, D.L. "Auditory Deficiencies of Poor Readers," Clinical Studies in Reading II, Supplementary Educational Monographs, 1953, p.77.

Popps, H. "Visual Discrimination of Alphabet Letters," Reading Teacher, 17, January, 1964, pp.221-226.

Singleton, C. "Phonics as One of the Word Attack Skills," Wide World of Reading Instruction, Vol.5, Lehigh University, 1966, pp.41-45. Editor Albert J. Mazurkiewicz.

Smith, N.B. "Matching Ability as a Factor in First Grade Reading," Journal of Educational Psychology, 19, 1928, pp.560-571.

Staats, C.. A. Staats, R. Schultz. "The Effects of Discrimination Pretraining on Textual Behavior," Journal of Educational Psychology, 53, 1962, pp.32-37.

Strickland, R. "Implication of Research in Linguistics for Elementary Teaching," Elementary English, 40, 1963, pp.168-171.

Templin, M. "Phonic Knowledge and Its Relation to the Spelling and Reading Achievement of Fourth Grade Pupils," Journal of Educational Research, 47, February, 1954, pp.441-454.

Thompson, B. "A Longitudinal Study of Auditory Discrimination," Journal of Educational Research, 56, March, 1963, pp.376-378.

Vernon, M. "The Perceptual Process in Reading," *The Reading Teacher*, 13, 1959, pp.2-7

Wepman, J. "The Interrelationships of Hearing, Speech and Reading," *Reading Teacher*, 14, March 1961, pp.245-247.

__________. "Auditory Discrimination, Speech and Reading," *The Elementary School Journal*, 60, March, 1960, pp.325-333.

Wheelock, W. and N. Silvaroli. "Visual Discrimination Training for Beginning Readers," *Reading Teacher*, 21, November, 1967, pp.115-120.

C. THESES

Benger, K. "A Study of the Relationship Between Perception, Personality, Intelligence and Grade One Reading Achievement," Unpublished Master's Thesis, University of Alberta, 1966.

Brown, S. "An Investigation of the Relationship Between A Knowledge of Letter Names and Sounds and The Mastery of an Initial Sight Vocabulary," Ph.d. Dissertation, University of Connecticut, 1966, Vol.27. p.3358-A.

Cosens, G. "An Experimental Study of the Effect of Training in Auditory Discrimination on Reading Achievement in Grade One," Unpublished Master's Thesis, University of Alberta, 1968.

Fast, D. "The Effect of Socio-Economic Status on the Development of Auditory Discrimination as it Relates to Reading Achievement," Unpublished Master's Thesis, University of Alberta, 1968.

Lewis, A.J. "An Inventory of the Auditory and Visual Discrimination Abilities of Beginning Kindergarten Children," Unpublished Doctoral Dissertation, Microfilm, University of Iowa, 1959.

Marmon, M. "The Effectiveness of Alphabetic Recognition and Auditory Discrimination Training on Word Recognition," EDL. Dissertation, University of California, Los Angeles, 1966, Vol.27, p.3370-A.

Myers, D. "The Effects of Letter Knowledge on Achievement in Reading in First Grade," Ph.d. Dissertation, University of Missouri, Columbia, 1966. Vol.27. p.2449-A.

Oberg, A.G. "Auditory Discrimination Ability of Children in Kindergarten, Grades One, Two, and Three," Unpublished Master's Thesis, University of Alberta, 1969.

Poling, D.L. "The Relationship of Auditory Discrimination to Reading Achievement," Unpublished Doctoral Dissertation, Microfilm, University of Chicago, 1968.

Reid, R. "Auditory Aspects of Reading Readiness," Unpublished Master's Thesis, University of Alberta, 1962.

Wheatley,M. "A Study of the Relationship Between Certain Visual Perceptual Abilities and Achievement in First Grade Reading," Unpublished Master's Thesis, University of Alberta, 1965.

APPENDIXES

APPENDIX A

ADMINISTRATION OF THE *FAST-COSENS AUDITORY DISCRIMINATION TEST*

FAST-COSENS AUDITORY DISCRIMINATION TEST

Practice Items

1. side ride
2. thimble thimble
3. zip gyp
4. fell fell
5. nice knife
6. paint faint

Practice Items on Tape

1. rack rat
2. bag bag
3. cup cut
4. wide wide
5. slimmer slinger
6. lung rung

ADMINISTRATION OF THE FAST-COSENS AUDITORY DISCRIMINATION TEST

(Fast, 1968:175-183)

1. Each child was tested individually.
2. Each child faced the experimenter.

Following are the directions for administering the test.

Today we are going to play a game with words. In order to play this game, I will give you two words at a time, and you are to tell me if the words are the same or different. If I say the word twice, that is, if the second word is exactly the same as the first word, I want you to keep your hands on your desk - like this, (demonstrate for the child). If the words are different, that is, if you hear a change and the second word does not sound exactly like the first one, put your hand up - like this, (demonstrate for the child). Sometimes the words will rhyme, but they are not exactly the same.

Listen! I will give you two words and you are to tell me if they are the same or different, "wide", "ride". Are those the same or are they different? Show me! Yes, you are right, - the two words are different, so you lift up your hand.

Now let us try a few word pairs for practice, to make sure that you know how to play the game. (Give the examinee the practice items listed)

If after the practice items, a child still had trouble understanding the directions or the concept of 'same' and

'difference', additional practice items were given.

If the examinee understood the task, the test was ready to proceed.

I am going to switch on the tape recorder and see if you can play this game by listening to the words on the tape. Remember, if the words sound the same, you keep your hands on your desk. If the words sound different, you put your hand up high. All right! Are you ready? Listen carefully! Two word-pairs were then played on the tape, "rack-rat, and bag-bag." The children were then asked to respond to these two word-pairs. If no difficulty was observed by the investigator, the test was ready to proceed.

The tape was again started, and the next four word-pairs (the rest of the practice items) were voiced on the tape, but not recorded by the investigator. This was to permit the examinee to get used to the rate and the intervals between word-pairs as presented on the tape recording.

THE FAST-COSENS AUDITORY DISCRIMINATION TEST

1. witch wish
2. cap cap
3. bug bug
4. pleasure pledger
5. chin chin
6. seed seed
7. ring wing
8. first thirst
9. volt bolt
10. harsh harsh
11. shake shake
12. sheep cheap
13. reshine reshing
14. sink sink
15. lease leash
16. gaze gaze
17. red red
18. hash hatch
19. wed wed
20. dare dare
21. sheet sheet
22. pie thigh
23. raging raging
24. peeve peeve
25. slim sling
26. brimming brimming
27. nice nice
28. leap weep
29. breed breathe
30. wife wife
31. bad bag
32. thatch thatch
33. shape shape
34. has has
35. region reason
36. mess mess
37. cherry sherry
38. lath lash
39. by by
40. thine vine
41. tenth tenth
42. switches swishes
43. wishing wishing
44. chains chains
45. swimming swinging
46. swim swim
47. elect erect
48. led led
49. boat boat
50. robe rode
51. clove clove
52. rocking rotting

53. van van
54. rash wrath
55. lap lap
56. muscle muffle
57. shack sack
58. range range
59. card card
60. lathe laid
61. shin shin
62. bathe bathe
63. then then
64. lath lass
65. day they
66. lit lit
67. way lay
68. legion legion
69. lash latch
70. by thy
71. cup cup
72. teething teething
73. bid bid
74. lesion legion
75. laid laid
76. simmer simmer
77. fought thought
78. ban van
79. wrath wrath
80. lass lash
81. sack sack
82. fearing feeling
83. roughing roughing
84. thought thought
85. thin thin
86. mesh mess
87. lap rap
88. rub rub
89. rap wrath
90. day day
91. popping potting
92. sherry sherry
93. thatch patch
94. ring ring
95. reason reason
96. has has
97. pick thick
98. grease grease
99. muff muff
100. ran rang
101. pie pie
102. peep peep
103. raising raging
104. push push
105. cheat sheet
106. bat bat

107. lit lick
108. leap leap
109. thy vie
110. cashing cashing
111. rains range
112. brimming bringing
113. slim slim
114. cad cad
115. clove clothe
116. waking waiting
117. vow vow
118. hearth harsh
119. rate rate
120. shake sake
121. page page
122. had had
123. bathe bade
124. thy thy
125. tenth tense
126. sing sing
127. dare there
128. lot lot
129. wait late
130. elect elect
131. pleasure pleasure
132. sinner sinner
133. mush muff
134. bath bath
135. shief thief
136. muss muff
137. cad cab
138. pushy pushy
139. cashing catching
140. reep reep
141. feeling feeling
142. grief grease
143. thorn thorn
144. waking waking
145. winning winging
146. popping popping
147. roughing rushing
148. clang clang
149. page pays
150. rate late
151. sun sung
152. thy thy
153. bail vale
154. rub rug
155. half hash
156. raft raft
157. fence thence
158. rung rum
159. cuffing cuffing
160. beater beaker

161. lot lock
162. peak peep
163. wing wing
164. naval naval
165. arriving arising
166. thy die
167. has have
168. lasses lashes
169. thigh thigh
170. fought fought
171. cog cob
172. hopper hotter
173. crutches crutches
174. bat that
175. pass pass
176. big bid
177. singer simmer
178. chat chap
179. lathe lave
180. dish dish
181. after aster
182. vow thou
183. sought thought
184. buzz buzz
185. wag rag
186. lashing laughing
187. closing clothing
188. late late
189. lens lend
190. lash lash
191. rising rising
192. wins wins
193. thank shank
194. rig rig
195. sheep sheath
196. latch latch
197. pup puff
198. winging winging
199. aster aster
200. witches wishes
201. web wed
202. lease lease
203. coke cope
204. puff puff
205. shoot shoot
206. laugh lash
207. sheep sheep
208. closing closing
209. leaf lease
210. thief thief
211. hash hash
212. beaker beaker
213. sinner singer
214. upper upper

215. refine reshine
216. swinging swinging
217. thin thin
218. gaze gaze
219. lashing lashing
220. red led
221. win wing
222. rug tub
223. lasses lasses
224. clam clang
225. muffle muffle
226. lake late
227. shape shake
228. rack rack
229. thimble symbol
230. sung sung
231. arising arising
232. naval nasal
233. shot shop
234. peeve pease
235. hotter hotter
236. pussy pushy
237. first first
238. thence thence
239. bolt bolt
240. slitting slipping
241. switches switches
242. chat chat
243. thee be
244. mouse mouse
245. led leg
246. laugh laugh
247. rotting rotting
248. vale vale
249. sift shift
250. cap cat
251. lathe lathe
252. cuffing cussing
253. there there
254. sink think
255. raft waft
256. rising writhing
257. wind wins
258. wag wag
259. teething teasing
260. shin thin
261. cog cog
262. wreath reap
263. soak soak
264. wish wish
265. leap leaf
266. pass path

APPENDIX B

VISUAL TEST

ADMINISTRATION OF THE VISUAL TEST

A group of ten to fifteen children were usually tested in one sitting.

Directions for the administration of the test are as follows:

I want you all to look at the board. On the board you can see two words with a dotted line between them.

ride ....wide
sat ....mat
cap ....cap

I want you to look carefully at the first two of words (point). Do those two words look exactly the same or do they look different? They are different. If they are not the same, that is if they are different, put an X on the dotted line between them. Look at the next row. Are they exactly the same or do they look different? They are different so we put an X on the line. Look at the last row. Are the words exactly the same or different? They are the same. If they are exactly the same do not put anything on the line. Do you think you can see which ones are the same or different in this booklet? Remember to look ever so closely and if the words look the same to not put anything on the line, but if they are different put an X on the dotted line.

Hand out the booklets and children can begin work at once.

VISUAL TEST

witch .... wish
cap ....cap
bug ....bug
pleasure .....pledger
chin ....chin
seed ....seed
ring ....wing
first ....thirst
volt ....bolt
harsh ....harsh
shake ....shake
sheep ....cheap
reshine .....reshine
sink ....sink
lease ....leash
gaze ....gaze
red ....red
hash ....hatch
wed ....wed
dare ....dare
sheat ....sheat
pie ....thigh
raging ......raging
peeve ....peeve
slim ....sling
brimming .....brimming
nice ....nice
leap ....weep
breed ....breathe
wife ....wife
bad ....bag
thatch ......thatch
shape ....shape
had ....has
region ......reason
mess ....mess
cherry ......sherry
lath ....lash
by ....by
thine ....vine

tenth ......tenth
switches ...swishes
wishing ...wishing
chains .....change
swimming...swinging
swim ....swim
elect ......erect
led ....led
boat ....boat
robe ....rode
clove ......clove
rocking ....rotting
van ....van
rash ....wrath
lap ....lap
muscle .....muffle
shack ......sack
range ......range
card ....card
lathe ......laid
shin ....shin

bathe ....bathe
then ....then
lath ....lass
day ....they
lit ....lit
way ....lay
legion ......legion
lash ....latch
by ....thy
cup ....cup
teething.....teething
bid ....bid
lesion .....,legion
laid ....laid
simmer ......simmer
fought ......thought
ban ....van
wrath ....wrath
lass ....lash
sack ....sack
fearing .....feeling

roughing ....roughing
thought .....thought
thin ....thin
mesh ....mess
lap ....rap
rub ....rub
rap ....wrath
day ....day
popping .....potting
sherry ......sherry
thatch ......patch
ring ....ring
reason ......reason
has ....has
pick ....thick
grease ......grease
muff ....muff
ran ....rang
pie ....pie
peep ....peep
raising .....raging

push ....push
cheat ....sheet
bat ....bat
lit ....lick
leap ....leap
thy ....vie
cashing .....cashing
rains ....range
brimming ....bringing
slim ....slim
cad ....cad
clove ....clothe
waking ......waiting
vow ....vow
hearth ......harsh
rate ....rate
shake ....sake
page ....page
had ....had
bathe ....bade
thy ....thy

tenth ....tense
sing ....sing
dare ....there
lot ....lot
wait ....late
elect ....elect
pleasure .....pleasure
sinner ....sinner
mush ....muff
bath ....bath
shief ....thief
muss ....muff
cad ....cab
pushy ....pushy
cashing ......catching
reep ....reep
feeling ......feeling
grief ....grease
thorn ....thorn
waking ....waking
winning ......winging

popping ......popping
roughing .....rushing
clang ....clang
page ....pays
rate ....late
sun ....sung
thy ....thy
bail ....vale
rub ....rug
half ....hash
raft ....raft
fence ....thence
rung ....rum
cuffing ......cuffing
beater ....beaker
lot ....lock
peak ....peep
wing ....wing
naval ....naval
arriving .....arising
thy ....die

has ....have
lasses ....lashes
thigh ....thigh
fought ....fought
cog ....cob
hopper ....hotter
crutches .....crutches
bat ....that
pass ....pass
big ....bid
singer ....simmer
chat ....chap
lathe ....lave
dish ....dish
after ....aster
vow ....thou
sought ....thought
buzz ....buzz
wag ....rag
lashing ......laughing
closing ......clothing

late ....late
lens ....lend
lash ....lash
rising ....rising
wins ....wins
thank ....shank
rig ....rig
sheep ....sheath
latch ....latch
pup ....puff
winging ......winging
aster ....aster
witches ......wishes
web ....wed
lease ....lease
coke ....cope
puff ....puff
shoot ....shoot
laugh ....lash
sheep ....sheep
closing ......closing

leaf ....lease

thief ....thief

hash ....hash

beaker ......beaker

sinner ......singer

upper ....upper

refine ......reshine

swinging ....swinging

thin ....thin

gaze ....gave

lashing .....lashing

red ....led

win ....wing

tug ....tub

lasses ......lasses

clam ....clang

muffle ......muffle

lake ....late

shape ....shake

rack ....rack

thimble .....symbol

sung ....sung

arising .....arising

naval ....nasal

shot ....shop

peeve ....pease

hotter ....hotter

pussy ....pushy

first ....first

thence ....thence

bolt ....bolt

slitting .....slipping

switches .....switches

chat ....chat

thee ....be

mouse ....mouse

led ....leg

laugh ....laugh

rotting ......rotting

vale ....vale

sift ....shift

cap ....cat

APPENDIX C

THE AUDITORY-VISUAL CORRESPONDENCE TEST

ADMINISTRATION OF THE
AUDITORY-VISUAL CORRESPONDENCE TEST

Following are the directions for administering the test:

I have many words on these sheets of paper in front of you. There are two words in each row. You do not have to read the words. All the words are made up of letters. I will point to one or two letters in each row and I want you to give me the sound that letter stands for. Let us look at this word. (Note: the letters underlined are those to which the examiner pointed.)

ten What sound does the t (examiner point) stand for? Let's try another word. sat What sound does the s (examiner point) stand for?

Let's try some more words for practice.

bat	pat	wide	ride

The child was corrected if he gave the name rather than the sound. When the child understood the directions, the test continued. Those children who could not verbalize the sound voluntarily indicated so by shaking his head or indicated in some other manner.

The Auditory-Visual Correspondence Test is given below. Those sounds tested in each word of the word pair are underlined. The original copy of the test had only one column of word pairs printed in much larger primer print. The letters were not underlined for the pupils. During the testing situation, no children attempted to read the words orally.

AUDITORY-VISUAL CORRESPONDENCE TEST

1. cap cap
2. bug bug
3. pleasure pleasure
4. chin chin
5. seed seed
6. ring wing
7. first thirst
8. volt bolt
9. harsh harsh
10. shake shake
11. sheep cheap
12. reshine reshine
13. sink sink
14. lease leash
15. gaze gaze
16. red red
17. wed wed
18. dare dare
19. sheat sheat
20. pie thigh
21. raging raging
22. peeve peeve
23. slim sling
24. brimming brimming
25. nice nice
26. leap weep
27. wife wife
28. bad bag
29. thatch thatch
30. shape shape
31. had has
32. region reason
33. mess mess
34. cherry sherry
35. lath lash
36. by by
37. thine thine
38. tenth tenth
39. wishing wishing
40. chains chains

41. swimming swinging
42. swim swim
43. elect erect
44. led led
45. boat boat
46. robe rode
47. clove clove
48. rocking rotting
49. van van
50. rash wrath
51. lap lap
52. muscle muffle
53. shack sack
54. range range
55. card card
56. shin shin
57. then then
58. lath lass
59. day they
60. lit lit
61. way lay
62. legion legion
63. by thy
64. cup cup
65. teething teething
66. bid bid
67. lesion legion
68. laid laid
70. simmer simmer
71. fought thought
72. ban van
73. wrath wrath
74. lass lash
75. sack sack
76. fearing feeling
77. thought thought
78. thin thin
79. mesh mess
80. lap rap
81. rub rub
82. rap wrath
83. day day

84. popping potting
85. sherry sherry
86. thatch patch
87. ring ring
88. reason reason
89. has has
90. pick thick
91. grease grease
92. muff muff
93. ran rang
94. pie pie
95. peep peep
96. raising raging
97. cheat sheet
98. bat bat
99. lit lick
100. leap leap
101. thy vie
102. cashing cashing
103. rains range
104. brimming bringing
105. slim slim
106. cad cad
107. waking waiting
108. vow vow
109. hearth harsh
110. rate rate
111. shake sake
112. page page
113. had had
114. thy thy
115. tenth tense
116. sing sing
117. dare there
118. lot lot
119. wait late
120. elect elect
121. pleasure pleasure
122. sinner sinner
123. mush muff
124. bath bath
125. shief thief

126. muss muff
127. cad cab
128. pushy pushy
129. reep reep
130. feeling feeling
131. grief grease
132. thorn thorn
133. waking waking
134. winning winging
135. popping popping
136. clang clang
137. page pays
138. rate late
139. sun sung
140. thy thy
141. bail vale
142. rub rug
143. half hash
144. raft raft
145. fence thence
146. rung rum
147. cuffing cuffing
148. beater beaker
149. lot lock
150. peak peep
151. wing wing
152. naval naval
153. arriving arising
154. thy die
155. has have
156. lasses lashes
157. thigh thigh
158. fought fought
159. cog cob
160. hopper hotter
161. bat that
162. pass pass
163. big bid
164. singer simmer
165. chat chap
166. dish dish
167. after aster

168. vow thou
169. sought thought
170. buzz buzz
171. wag rag
172. closing clothing
173. late late
174. lens lend
175. lash lash
176. rising rising
177. wins wins
178. thank shank
179. rig rig
180. sheep sheath
181. pup puff
182. winging winging
183. aster aster
184. web wed
185. lease lease
186. coke cope
187. puff puff
188. shoot shoot
189. sheep sheep
190. closing closing
191. leaf lease
192. thief thief
193. hash hash
194. beaker beaker
195. sinner singer
196. upper upper
197. refine reshine
198. swinging swinging
199. thin thin
200. gaze gave
201. lashing lashing
202. red led
203. win wing
204. tug tub
205. lasses lasses
206. clam clang
207. muffle muffle
208. lake late
209. shape shake

210. rack rack

211. thimble symbol

212. sung sung

213. arising arising

214. naval nasal

215. shot shop

216. peeve pease

217. hotter hotter

218. pussy pushy

219. first first

220. thence thence

221. bolt bolt

223. slitting slipping

224. chat chat

225. thee be

226. mouse mouse

227. led leg

228. rotting rotting

229. vale vale

230. sift shift

231. cap cat

232. cuffing cussing

233. there there

234. sink think

235. raft waft

236. rising writhing

237. wind wins

238. wag wag

239. teething teasing

240. shin thin

241. cog cog

242. wreath reap

243. soak soak

244. wish wish

245. leap leaf

246. pass path

APPENDIX D

Total Scores on Criterion Tests

TOTAL SCORES ON CRITERION TESTS BY

HIGH READING ACHIEVERS

Student	Auditory Test	Visual Test	Auditory-Visual Test
1	220	264	234
2	222	264	234
3	240	265	227
4	240	265	242
5	225	262	235
6	234	263	227
7	226	259	206
8	202	261	169
9	244	266	208
10	222	259	237
11	242	262	297
12	219	160	229
13	243	259	220
14	243	250	138
15	242	257	212
16	228	250	217
17	244	258	213
18	239	260	218
19	197	260	225
20	222	266	235
21	212	263	235
22	251	260	219
23	221	261	219
24	193	262	228
25	212	260	222
26	201		
27	223	233	235
28	233	260	223
29	217	259	230
30	255	262	241

TOTAL SCORES ON CRITERION TESTS BY LOW READING ACHIEVERS

Student	Auditory Test	Visual Test	Auditory-Visual Test
1	188	237	118
2	139	234	53
3	210	242	34
4	204	204	0
5	203	244	115
6	224	242	30
7	214	223	21
8	233	219	40
9	228	246	33
10	217	235	64
11	179	247	30
12	182	244	108
13	181	243	0
14	205	257	-
15	235	229	123
16	241	251	37
17	190	251	62
18	135	196	38
19	203	261	123
20	232	224	96
21	198	256	12
22	156	193	23
23	213	246	41
24	189	266	122
25	216	262	106
26	185	255	25
27	208	256	75
28	219	180	93
29	188	146	56
30	232	245	-

B29980